TDRR 33991 JUN 22 1967

AUTHORIZED SIGNATURES	REPRESENTING	DATE
	GAEC	
W. Stameris	MIT/IL	16 June 1967

INTERFACE REVISION NOTICE

INTERFACE CONTROL DOCUMENT

GRUMMAN AIRCRAFT
ENGINEERING CORPORATION
BETHPAGE, L. I., NEW YORK

CODE IDENT NO. 26512

IRN NO: LID-340-10000-5
Sheet 1 of 1

ICRA NO: 10-141
Page 2 of 2

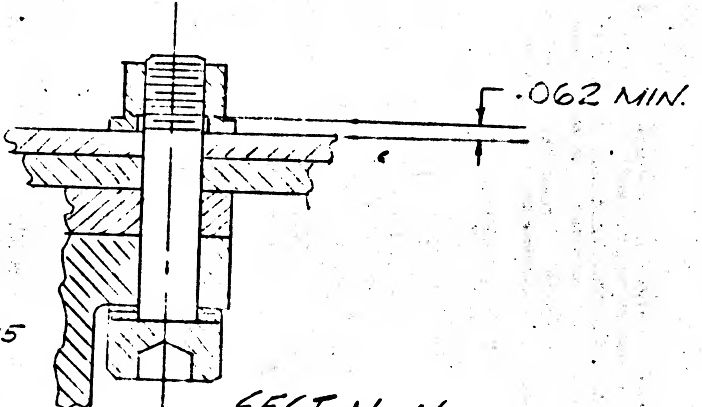
ICD NO. LID-340-10000

CCA NO. **DATE**

ICD TITLE
PGNS (LGC-CDU-PSA and Signal Condition Installation

THIS DOCUMENT SPECIFIES TECHNICAL REQUIREMENTS BETWEEN ALL PARTIES AFFECTED HEREIN. NOTHING CONTAINED IN THIS DOCUMENT SHALL BE DEEMED TO ALTER THE TERMS OF ANY CONTRACT OR PURCHASE ORDER BETWEEN GAEC AND THE ADDRESSEE.

DESCRIPTION: IN SECTION N-N ADD. COUNTERBORE DIM. AS SHOWN.



SECT. N-N

VEH. EFF.-LTA-3, LM3 THRU 15

REASON: DRAWING ERROR

DRAWN BY: R STONE

ENG 37.3 1-64

TDRR 25190 JAN 11 1966

AUTHORIZED SIGNATURES	REPRESENTING	DATE
Bukker D.R. Test 9/28/65	GAEC	12/6/65
D.G. Hoag	MIT	30 Sept

INTERFACE REVISION NOTICE

INTERFACE CONTROL DOCUMENT

NAS 9-1100 Line Item 13
Exhibit E Primary No. 697
Para. 5.6.2 Type II

GRUMMAN AIRCRAFT
ENGINEERING CORPORATION
BETHPAGE, L. I., NEW YORK

CODE IDENT NO: 26512

IRN NO: ~~LID-340-10000-1~~
~~Sheet 1 of 1~~

ICRA NO: 10-109
Sheet 2 of 2

ICD NO. LID-340-10000

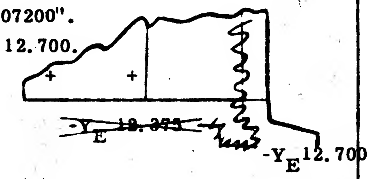
CCA NO. DATE 12-6-65

ICD TITLE
Interface Control Document
PGNS (LGC-CDU-PSA & Signal Cond.) Inst.

THIS DOCUMENT SPECIFIES TECHNICAL REQUIREMENTS BETWEEN ALL PARTIES AFFECTED HEREIN. NOTHING CONTAINED IN THIS DOCUMENT SHALL BE DEEMED TO ALTER THE TERMS OF ANY CONTRACT OR PURCHASE ORDER BETWEEN GAEC AND THE ADDRESSEE.

DESCRIPTION:

1. Zone 2: In Parts List, change PSA P/N from: "MIT-124994" to: "6007200".
2. Zone 5: In view of PSA looking aft, change from: $-Y_E$ 12.375 to: $-Y_E$ 12.700. (.325 inch added to connector end of PSA. Additional cold-plate optional under this length increment.)



3. Zone 5: Change callout note from: "Fasten PSA & G&N Signal Conditioner (MIT 124994)" to: "Fasten PSA (6007200) & G&N Signal Conditioner (6007010)".
4. Zone 10: Change CDU length from: "20.562 max." to: "20.250".
5. Zone 12; Detail C: Change title from: "...for PSA & G&N Signal Conditioner (MIT-124994)" to: "...for PSA (6007200) & G&N Signal Conditioner (6007010)". Change PSA length from: "23.000" to: "23.325". Correct picture of the two views accordingly.

REASON: (a) Update assembly part numbers. (b) Change from maximum to nominal on CDU length. (c) Add .325" to connector end of PSA to increase spare pin margin and permit addition of module at one end of connector, if required.

NOTE: As a result of discussions with GAEC, this ICRA supersedes ICRA 10-101 transmitted by MIT letter AG 813-65, dated 8 September 1965. Cancel ICRA 10-101.

D.R. Test 9/28/65

REASON: See Above

DRAWN BY: D. R. Test

TDRR 25190 JAN 11 1966

AUTHORIZED SIGNATURES	REPRESENTING	DATE
E. Stern	GAEC	9/25/65
D. G. Hoag	MIT	3 Jan 66

INTERFACE REVISION NOTICE

INTERFACE CONTROL DOCUMENT

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
BETHPAGE, L. I., NEW YORK

CODE IDENT NO. 26512

IRN NO: LID-340-10000-2
Sheet 1 of 1

ICRA NO: 10-030
Page 2 of 2

ICD NO. LID-340-10000

CCA NO. **DATE** 1-3-66

ICD TITLE PGNS (LGC-CDU-PSA & SIG COND) INSTALLATION

THIS DOCUMENT SPECIFIES TECHNICAL REQUIREMENTS BETWEEN ALL PARTIES AFFECTED HEREIN. NOTHING CONTAINED IN THIS DOCUMENT SHALL BE DEEMED TO ALTER THE TERMS OF ANY CONTRACT OR PURCHASE ORDER BETWEEN GAEC AND THE ADDRESSEE.

DESCRIPTION:

Change Note 12 as follows: Delete "Design Data Required" and add "Thermal Interface Material (RTV 601 - Filled 25% by WT. 325 Mesh AL_2O_3) to be Applied per 17 between the LGC, CDU, PSA/SCA and Their Respective Cold Plates."

Add Note 17 as follows: 17 17. Design Data Required

REASON: Definition of Thermal Interface Material

DRAWN BY: E. Baade

ENG 37.3 1-64

TDRR 33991 JUN 22 1967

AUTHORIZED SIGNATURES	REPRESENTING	DATE
G. E. Smith	GAEC	3-21-67
W Stameris	MIT/IL	1 May 67

INTERFACE REVISION NOTICE

INTERFACE CONTROL DOCUMENT

NAS 9-1100 Line Item 13
Exhibit E Primary No. 697
Para. 5.6.2 Type II

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
BETHPAGE, L. I., NEW YORK

CODE IDENT NO. 26512

IRN NO: LIS 510-10001A-5
Sheet 1 of 1

ICRA NO: 10-223
Page 2 of 2

ICD NO. LIS-510-10001A

CCA NO. DATE 5/1/67

ICD TITLE
Thermodynamic Requirements of Guidance and Navigation Equipment.

THIS DOCUMENT SPECIFIES TECHNICAL REQUIREMENTS BETWEEN ALL PARTIES AFFECTED HEREIN. NOTHING CONTAINED IN THIS DOCUMENT SHALL BE DEEMED TO ALTER THE TERMS OF ANY CONTRACT OR PURCHASE ORDER BETWEEN GAEC AND THE ADDRESSEE.

DESCRIPTION:

Add Paragraph 1.7 to ICD

1.7 LM-1 Coolant Flow Rate

The coolant flow rate for LM-1 flight operation of the PGNS (LGC, CDU, PSA, IMU & PTA) shall be within the range of 28 and 66 lbs per hour. The same coolant inlet temperature range of 32°F to 50°F shall still apply.

Add to Paragraph 1.2.2.1

For LM-1 coolant flow rates refer to Paragraph 1.7

Add to Paragraph 1.2.3.1

For LM-1 coolant flow rates refer to Paragraph 1.7

Add to Figure 2

For LM-1 coolant flow rates refer to Paragraph 1.7

VEHICLE EFFECTIVITY: LM-1

REASON: Use both primary and redundant pumps on primary coolant loop.

DRAWN BY: J. Rizzuto

[illegible] 37.3 1-66

TDRR 25189 JAN 11 1966

AUTHORIZED SIGNATURES	REPRESENTING	DATE
E Stern	GAEC	12/21/65
D.G. Hoag by W Stameris	w/s MIT/IL	22 Dec 65

INTERFACE REVISION NOTICE

INTERFACE CONTROL DOCUMENT

GRUMMAN AIRCRAFT
ENGINEERING CORPORATION
BETHPAGE, L. I., NEW YORK

CODE IDENT NO. 26512	IRN NO: LIS-510-10001 A-1 SHEET 1 OF 1
	ICRA NO: 10-051 PAGE 2 OF 2

ICD NO. LIS-510-10001 REV A

CCA NO. DATE 12-22-65

ICD TITLE THERMODYNAMIC REQUIREMENTS OF GUIDANCE AND NAVIGATION EQUIPMENT

THIS DOCUMENT SPECIFIES TECHNICAL REQUIREMENTS BETWEEN ALL PARTIES AFFECTED HEREIN. NOTHING CONTAINED IN THIS DOCUMENT SHALL BE DEEMED TO ALTER THE TERMS OF ANY CONTRACT OR PURCHASE ORDER BETWEEN GAEC AND THE ADDRESSEE.

DESCRIPTION:

RE: LIS-510-10001, REV. A, DATED 7-30-65

PAGE 5 OF 10, PARAGRAPH 1.2.3.2 - DELETE "④①②" AND REPLACE WITH "... +40°F TO +63°F. IN THE EVENT OF A LOSS OF POWER IN THE LEM ABORT SENSOR ASSEMBLY (ASA), THE COOLANT INLET TEMPERATURE TO THE PTA WILL BE +32°F TO +50°F."

PAGE 8 OF 10, PTA INLET TEMP. - REPLACE "32°F-65°F"
WITH "+40°F - +63°F (ASA OPERATING)"
"+32°F - +50°F (ASA FAILURE)"

REASON: SPECIFY PTA COOLANT TEMPERATURE

DRAWN BY: E. CLASH

ENG 37.3 1-64

TDRR 21638 AUG 17 1965

AUTHORIZED SIGNATURES	REPRESENTING	DATE	INTERFACE REVISION NOTICE	CODE IDENT NO.	IRN NO: LIB-350-10001-01 Sheet 1 of 8
E. St...D	GAEC	7/30/65	INTERFACE CONTROL DOCUMENT	26512	ICRA NO:
				ICD NO. LIB-350-10001	
				CCA NO.	DATE
D.G. Hoag	MIT	30 Jul 65	GRUMMAN AIRCRAFT ENGINEERING CORPORATION BETHPAGE, L. I., NEW YORK	ICD TITLE TOTAL ATTITUDE SIGNAL, ELECTRICAL INTERFACE BETWEEN THE PGNS AND THE GASTA	

THIS DOCUMENT SPECIFIES TECHNICAL REQUIREMENTS BETWEEN ALL PARTIES AFFECTED HEREIN. NOTHING CONTAINED IN THIS DOCUMENT SHALL BE DEEMED TO ALTER THE TERMS OF ANY CONTRACT OR PURCHASE ORDER BETWEEN GAEC AND THE ADDRESSEE.

DESCRIPTION:

(1) Changes to Total Attitude Signals.

(2) Addition of Attitude Error Interface.

(3) Addition of IMU Cage Signal.

See attached pages 2 thru 8.

REASON:

DRAWN BY:

ENG 37.3 1-64

LIB-350-10001

Sheet 1: Change title to: LEM-PGNS Electrical Interface for total Attitude Signals, Attitude Error Signals, and IMU Cage Signal.

Sheet 4: Change "NOTE" to "SCOPE" and replace both paragraphs under NOTE with the following:

Scope: The total attitude, attitude error, and IMU cage electrical interfaces between the Primary Guidance and Navigation System (PGNS) and the Lunar Excursion Module (LEM) are defined. The Signals are defined at the PGNS interface connector when operating in any vehicle control mode requiring these signals.

The functional interface requirements between PGNS and LEM are defined in LIS-540-10001.

Sheet 4: Change paragraph 1 to read "Total Attitude Signals."

Sheet 4: Change paragraph 1.1 to read "Definition of Voltages."

Sheet 4: Paragraph 1.1.2: Change from "resolver excitation" to "reference."

Sheet 4: Delete paragraph 1.1.4 and replace with:

1.1.4 Amplitude:

$K_1 E_0 \sin(vt + \theta) = 26 \pm 10\%$ volts RMS

Sheet 5: Paragraph 1.1.7, first sentence: Change from "excitation" to "reference."

Sheet 5: Paragraph 1.1.7, second sentence: Add "for any axis" after K_2.

Sheet 5: Paragraph 1.1.8: Replace "190 + j 150" with "180 + j 70."

Sheet 7: Paragraph 1.1.11, last paragraph: Change from "excitation" to "reference."

Sheet 7: Add paragraph 1.2 as follows:

1.2 Reference Voltage: The 800 cps power defined in LIB370-10001 is defined as the reference voltage and defines zero phase when measured from "800 cps reference - LOW" to "800 cps reference."

Sheet 8: Delete Figure 4 and replace with Figure 4 (attached).

Sheet 9: Figure 5: Add "For Reference Only."

Add the following:

2. Attitude Error Signals

2.1 Specification of Signals

2.1.1 Reference voltage as specified in PARAGRAPH 1.2.

2.1.2 Attitude Error Signal Components.

2.1.2.1 The attitude error signal shall consist of three component attitude error voltages each supplied on a pair of grounded isolated lines. Each error signal shall be of the following form

$E_s = A_e K_{eo} \sin(wt + \theta)$

Where: E_s = Attitude error voltage (designated E_x, E_y, and E_z for corresponding vehicle axes)

K_{eo} = Scale factor in volts per degree

A_e = Attitude error component angle in degrees (designated A_x, A_y, and A_z for corresponding vehicle axes).
A_e varies incrementally and corresponds to a difference between the actual vehicle attitude and a commanded attitude.

θ = Carrier phase shift with respect to reference voltage.

$W = 2\pi(800)$ Radians/sec

2.1.2.2 Attitude Error Signal Carrier: The attitude error signal carrier shall be an 800 cps sinusoidal voltage synchronous with the reference voltage and linearly proportional to attitude error.

The attitude error voltage shall never exceed 10 volts rms for circuit protection consideration.

2.1.2.3 Source Impedance = 1K Ω Max. $\angle 0°$ (Reference).

2.1.2.4 Load Impedance and Scale Factor: The load presented by the Display Subsystem to each attitude error shall be as follows:

$Z = 20K \pm 5\% \angle 0°$

K_{eo} (sin wt) = 0.3 ±13% rms volts per degree

Total range = ±16 7/8 degrees

2.1.2.5 Phase Shift: The phase shift between each attitude error voltage Es and the reference voltage Eo shall be as follows:

$|\theta| \leqq 8°$ for $E_s = 1.8$ volts (corresponding to an error $A_e = 6°$)

2.1.2.6 Null Voltage: Total null (consisting of harmonics and quadrature) shall not exceed 56 millivolts rms (when $A_e = 0$).

2.1.2.7 Resolution: The attitude error signal resolution is 13.18 $\frac{MV}{BIT}$

Least Significant Bit = 158.2 sec.

2.1.2.8 Response: The response of the attitude error signal shall be as defined in LIS-540-10001.

2.1.2.9 Signal Phase: The attitude error signal phasing is defined one body axis at a time using positive rotation measured from IMU gimbal zero position as shown.

A positive rotation is defined as a clockwise rotation of the vehicle about an axis viewed from the inside of the vehicle out along the positive direction of the axis (see Figure 2).

For a positive vehicle rotation from 0° to 180° and zero command angles, the attitude error signal voltage shall be in phase ( ) with the reference voltage. For a negative rotation from 0° to 180°, the attitude error signal voltage shall be out of phase (180° from) with reference voltage.

Add:
Figure 6: Attitude Error Interface Wiring
Figure 7: Attitude Error Interface Schematic

3. IMU Cage Signal

3.1 The IMU Cage Signal from LEM to the PGNS shall be as shown on Figure 8

3.2 Voltage: 28 VDC

3.3 Current: The maximum current shall be 0.075 ampere At 28 V DC

Add:
Figure 8: IMU Cage Interface Schematic

3.4 The switch closure is the signal to cage the IMU

TDRR 33838 MAY 22 1967

AUTHORIZED SIGNATURES	REPRESENTING	DATE
E Stern	GAEC	1/13/66
WStamerin	MIT/IL	13 Mar 67

INTERFACE REVISION NOTICE

INTERFACE CONTROL DOCUMENT

NAS 9-1100 Line Item 13
Exhibit E Primary No. 697
Para. 5.6.2 Type II

GRUMMAN AIRCRAFT
ENGINEERING CORPORATION
BETHPAGE, L. I., NEW YORK

CODE IDENT NO. 26512
IRN NO: Sh 1 of 2 LIS 370-10004 B-4
ICRA NO: 10-203 Page 9 of 18
ICD NO. LIS 370-10004 Rev. B
CCA NO. DATE 3/13/67
ICD TITLE LOC- LM Electrical Interface

THIS DOCUMENT SPECIFIES TECHNICAL REQUIREMENTS BETWEEN ALL PARTIES AFFECTED HEREIN. NOTHING CONTAINED IN THIS DOCUMENT SHALL BE DEEMED TO ALTER THE TERMS OF ANY CONTRACT OR PURCHASE ORDER BETWEEN GAEC AND THE ADDRESSEE.

DESCRIPTION:

(A) In Section I:

(1) On sheets 7 & 8, add the following to the remarks column of signals A29, A 30, A31, A32, A33, & A 34:

These signals will not be present in LM-1 due to the deletion of the Attitude Controller Assy. The interface will be left open at the ACA at the time the ACA is removed.

(2) On Sheet 9, add the following to the remarks column of signals C1, C2 & C3:

These signals will not be present in LM-1 due to the deletion of the Attitude Controller Assy. Each interface will be short circuited at the ACA at the time the ACA is removed.

(3) On sheet 9, add the following to the remarks column of signals B2, B3, B4, B5 & B6.

These signals will not be present in LM-1 due to the deletion of the Thrust/Translation Controller. The interface will be left open at the TTCA. at the time the T/TCA is removed.

(4) On sheet 11, add the following to the remarks column of signals F1, F2, F3, F4, F5 & F6.

These signals will not be used in LM-1 due to the deletion of the Rendezvous Radar. Each interface will be loaded with a 200 ohm resistor on the GAEC side of the interface.

REASON: Deletion of Attitude & Thrust/Translation Controller & Rend. Radar from LM-1

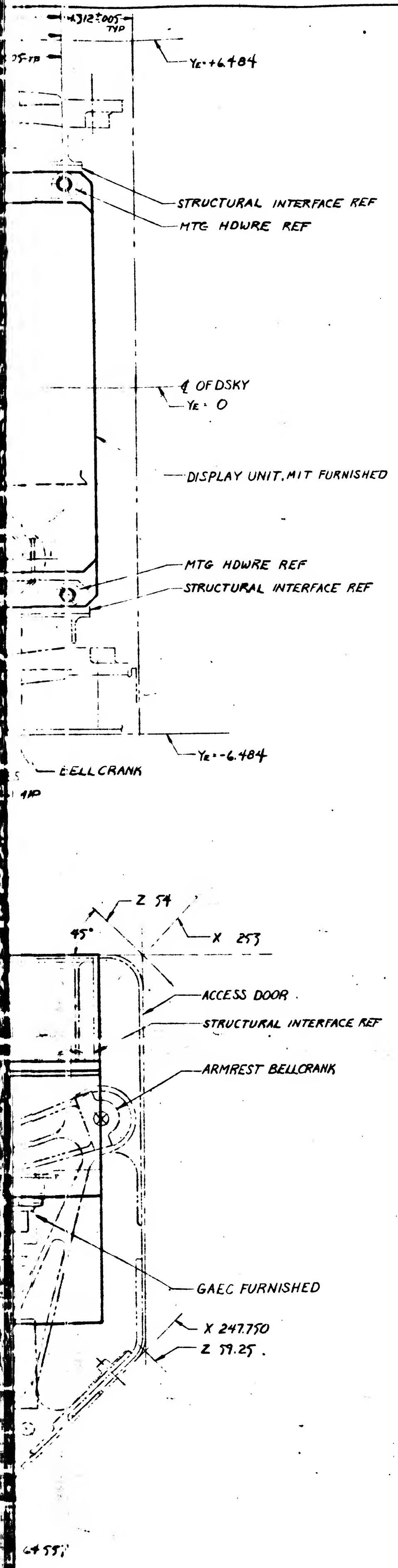
DRAWN BY: R.Kerr

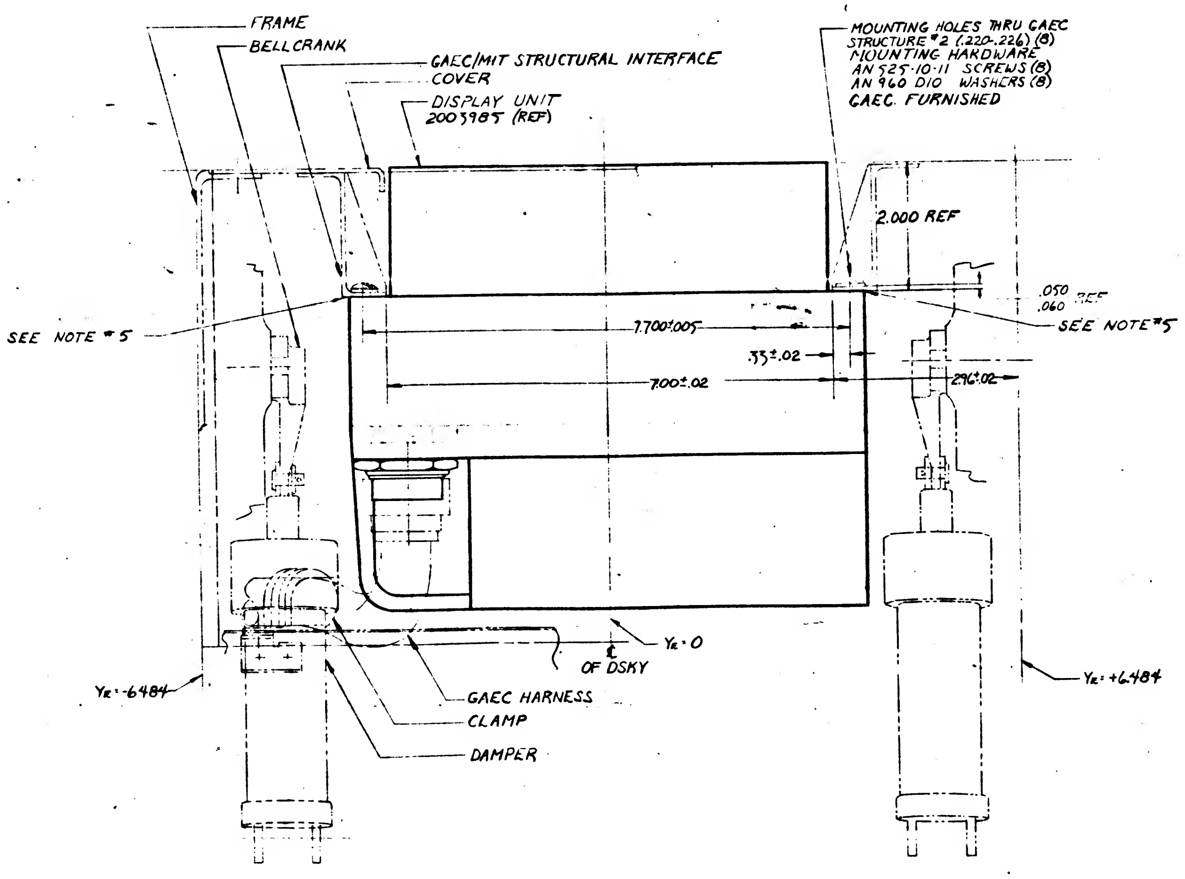
REVISIONS

REV LTR	EFF	ZONE	DESCRIPTION	REQ BY	CODE NO	APPROVALS	DATE

NOTES -

1. THIS DOCUMENT SPECIFIES TECHNICAL REQUIREMENTS BETWEEN ALL PARTIES AFFECTED HEREIN.
2. ALL VISIBLE SURFACES TO BE FINISHED IN ACCORDANCE WITH LID480-10002(REF)
3. ALL DIMENSIONS ARE IN INCHES. DECIMAL TOLERANCES UNLESS OTHERWISE NOTED; 2 PLACES ±.03, 3 PLACES ±.010, ANGULAR ±1°0'
4. INFORMATION SHOWN ON THIS RELEASE OF THIS I.C.D. SHALL BE CONSIDERED FINAL, EXCEPT THAT ADDITIONAL DETAIL WILL BE SHOWN ON SUBSEQUENT RELEASES IN ORDER TO FULFILL COMPLETE REQUIREMENTS OF THIS I.C.D.
5. BONDING DC RESISTANCE ACROSS METALLIC SURFACES SHALL BE 10 MILLIOHMS OR LESS. PROTECTION OF THESE SURFACES SHALL BE TEMPORARILY PROTECTED BY APPLYING A COAT OF MIL-C-16173 GRADE 4 CORROSION COMPOUND. ALUMINUM SURFACES TREATED PER MIL-C-5541 WITH ALODINE 1200S, NEEDS NO PROTECTION.
6. EACH DELIVERABLE ITEM WILL BE CONSIDERED ACCEPTABLE FOR PHYSICAL DIMENSIONS OF THE INTERFACE WHEN INSPECTED AND FOUND TO BE IN AGREEMENT WITH THE DIMENSIONS AS SPECIFIED ON THIS DRAWING. THIS INSPECTION MAY BE ACCOMPLISHED USING A GAEC SUPPLIED INSPECTION CHECKING FIXTURE.
   THE GAEC INSPECTION CHECKING FIXTURE WILL BE DESIGNED, FABRICATED, AND DIMENSIONALLY CHECKABLE TO THIS I.C.D. ASSOCIATE CONTRACTERS SHALL VERIFY THAT THE INSPECTION CHECKING FIXTURE IS IN AGREEMENT WITH THIS ICD AS A CONDITION OF ACCEPTANCE FOR USE AT THEIR FACILITY. GAEC WILL MAKE AVAILABLE MASTER TOOLING AND/OR GAUGES TO ASSOCIATE CONTRACTORS IF REQUESTED.
7. ALL PART NUMBERS SHOWN ARE FOR REFERENCE ONLY.
8. EFFECTIVITY: LTA 1,3,4,5,8 & LEM 1 THRU 11
9. PANEL COLORS TO CONFORM TO ICD
   MH 01-05174-414 & MH 01-01388-416.
10. MATERIAL AT INTERFACE IS:
    MIT: AL 6061-T6 PER QQ-A-250/11, ALODINED PER 1200S.
    GAEC: AL 7075-T6511/T651 PER QQ-A-277/282, ALODINED PER 1200 S.





VIEW LOOKING FORWARD

7-30-65

DRAWN BY	M. ROSS	7-29-65	GRUMMAN AIRCRAFT ENGRG CORP BETHPAGE, L. I., N. Y.
LAYOUT BY			
CREW PROV		7/29/65	INTERFACE CONTROL DOCUMENT LEM DSKY INSTALLATION
S.S. PROD			CONTRACT NO NAS 9-1100 DOCUMENT TYPE II
G.A.E.C.	F. Stern	8/2/65	CODE IDENT NO. 26512 / SIZE / LID 340-10010
G.A.E.C.		8/2/65	
M.I.T.			SCALE FULL / LINE ITEM #13 / SHEET 1 OF 1

34010010

REV A

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
BETHPAGE, L. I., NEW YORK

NAS 9-1100
Exhibit E
Para. 5.6.2
Line Item 13
Primary No. 665
Type II

TDRR 21625 AUG 17

INTERFACE CONTROL DOCUMENT

ICD NO. LIS-510-10001

THIS DOCUMENT SPECIFIES TECHNICAL REQUIREMENTS BETWEEN ALL PARTIES AFFECTED HEREIN. NOTHING CONTAINED IN THIS DOCUMENT SHALL BE DEEMED TO ALTER THE TERMS OF ANY CONTRACT OR PURCHASE ORDER BETWEEN GAEC AND THE ADDRESSEE.

APPROVALS

AUTHORIZED SIGNATURES	REPRESENTING	DATE
Perry L Gardner	GAEC	4/15/64
Arnold B Whitaker	GAEC	4/15/64
David G. Hoag	MIT	19 Jun 64

PREPARED BY: David B. Sullivan — David B. Sullivan
CHECKED: Arthur J. Katz — Arthur J. Katz

TITLE:

THERMODYNAMIC REQUIREMENTS OF GUIDANCE AND NAVIGATION EQUIPMENT
MIT - GRUMMAN

CCA NO.

REV	MODEL NUMBER	REV	MODEL NUMBER	REV	MODEL NUMBER

EFFECTIVITY

CODE IDENT NO.	SHEET	ICD NO.	REV
26512	1 OF 10	LIS-510-10001 30 July 1965	A

INTERFACE CONTROL DOCUMENT

ENG 37 1-64

REVISIONS

REV LTR	IRN NO.	SHEET	DESCRIPTION — INCLUDE CCA NUMBER	REV. BY	APPROVALS		DATE
A	NONE	ALL	COMPLETE ICD REVISION	E. CLASH	GAEC	E Stern	7/-0/65
					GAEC		
					MIT/IL	D.G. Hoag	30 Jul 65

KEY: Unless Otherwise Specified

1. Grumman Aircraft Engineering Corporation
   Bethpage, L.I., New York
2. Massachusetts Institute of Technology
   Cambridge, Massachusetts
3. National Aeronautics and Space Administration
   Manned Spacecraft Center
   Houston, Texas
4. Design Data to be supplied by:

---

1. General: The Guidance and Navigation equipment shall be capable of proper operation in the thermal environments of the LEM vehicle while being cooled by the LEM environmental control subsystem. The thermal design requirements and interfaces will be specified herein.

1.1 Methods of Thermal Control: The thermal control of the Guidance and Navigation (G & N) equipment is, in general, based on an active thermal control system wherein the equipment is conductively coupled to a coolant which must be capable of accepting all of the internally dissipated power and environmental heat inputs. The coupling of the actively cooled G & N equipment to the coolant loop will be accomplished by either integral cooling lines or attachment of the equipment to cold plates. Low power level equipment will be cooled passively.

1.1.1 Integral Cooling Lines: The Inertial Measurement Unit (IMU) will be cooled by permanently affixed cooling lines which are attached to the LEM ECS loop by quick disconnects.

1.1.2 Cold Plate Cooling: The LEM Power and Servo Assembly (LPSA), Coupling Display Units (CDU), LEM Guidance Computer (LGC) and Pulse Torque Assembly (PTA) will be cooled by the attachment of their heat sink surfaces to Grumman supplied cold plates.

1.1.3 Passive Cooling: The LEM G&N Display Panel and Alignment Optical Telescope (AOT) shall be passively cooled.

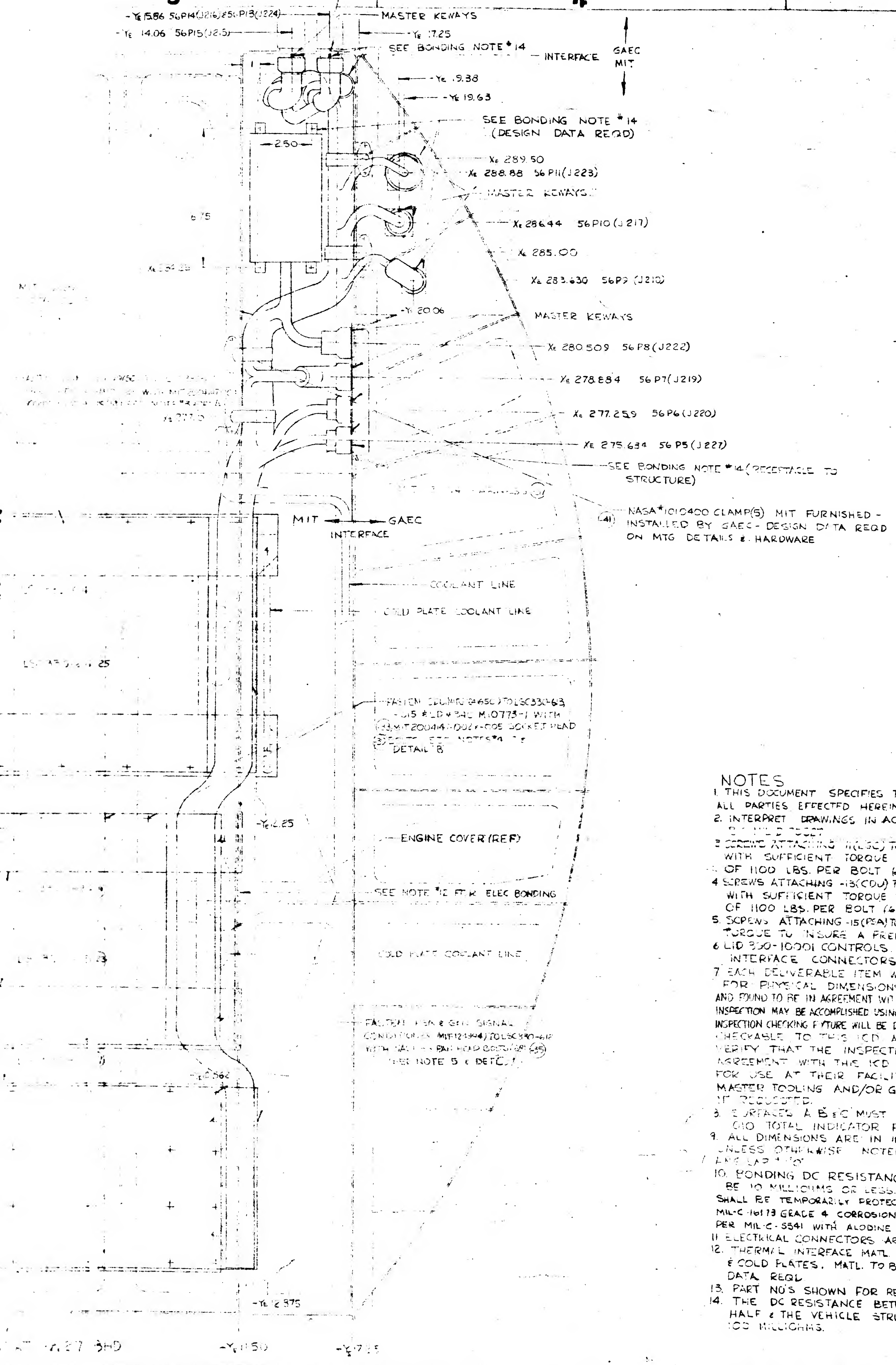
1.2 Cooling Parameters: The thermodynamic properties and requirements of the LEM environmental control subsystem for the three types of G&N equipment are as specified herein.

1.2.1 Coolant Properties: The approximate chemical composition and the physical properties of the LEM environmental control coolant will be as follows. The coolant will be approximately 35% ethylene glycol ($HOCH_2CH_2OH$) and 65% water (H_2O) by weight with Triethanolamine phosphate (TEAP) and Sodium mercaptobenzothiozol (NaMCBT) inhibitors. The heat capacity of this mixture as a function of temperature is shown in Figure 1.

1.2.2 Integral Cooling Lines:

1.2.2.1 Coolant Flow Rates: The mass flow rate of the environmental control coolant to the IMU cooling loop during manned phases of the mission will be thirty-three plus or minus five pounds per hour (33±5 lbs/hr). During unmanned translunar flight, there will be no coolant flow to the IMU.

1.2.2.2 Coolant System Pressure: The maximum design operating pressure for the coolant loop shall be 60 psig. The design proof pressure shall be 90 psig.


-YE 15.86 56P14(J216)&56P13(J224)
-YE 14.06 56P15(J215)
MASTER KEWAYS
-YE 17.25
SEE BONDING NOTE *14
INTERFACE
GAEC
MIT
-YE 19.38
-YE 19.63
SEE BONDING NOTE *14 (DESIGN DATA REQD)
2.50
XE 289.50
XE 288.88 56P11(J223)
MASTER KEWAYS
6.75
XE 286.44 56P10(J217)
XE 285.00
XE 283.630 56P9(J210)
-YE 20.06
MASTER KEWAYS
XE 280.509 56P8(J222)
XE 278.884 56P7(J219)
XE 277.259 56P6(J220)
XE 275.634 56P5(J227)
SEE BONDING NOTE *14 (RECEPTACLE TO STRUCTURE)
(41) NASA *1010400 CLAMP(5) MIT FURNISHED - INSTALLED BY GAEC - DESIGN DATA REQD ON MTG DETAILS & HARDWARE
MIT
GAEC
INTERFACE
COOLANT LINE
COLD PLATE COOLANT LINE
LSC 330-6 25
FASTEN CDU(MIT J124565C) TO LSC330-613 -015 & LDW 340-M10773-1 WITH (33) MIT 2004147-002 & -005 SOCKET HEAD (39) BOLTS SEE NOTES *4 & DETAIL B
-YE 2.25
ENGINE COVER (REF)
SEE NOTE *12 FOR ELEC BONDING
COLD PLATE COOLANT LINE
FASTEN PSA & GEN SIGNAL CONDITIONER (MIT 124994) TO LSC330-612 WITH GAEC PAN HEAD BOLTS (28) (35) SEE NOTE 5 & DET C
2.562
-YE 2.375
-YE 1.50
-YE 7.25
XE 27 BHD
4
4
5
4

LIST OF AFFECTED PARTS

DASH NO.	DESCRIPTION	NO. REQD PER INSTL	MATERIAL	SUPPLIER	REMARKS
-11	LEM GUIDANCE COMPUTER (LGC)	1		MIT	MIT-J-124965C
-13	COUPLING DISPLAY UNIT (CDU)	1		MIT	MIT-J 124985C
-15	POWER SERVO ASSY (PSA)	1		MIT	MIT-124994
-17	LSC 330-612 COLD PLATE	1		GAEC	
-19	LSC 330-613 COLD PLATE	1		GAEC	
-21	LSC 330-614 COLD PLATE	1		GAEC	
-23	LSC 330-615 COLD PLATE	1		GAEC	
-25	LSC 330-616 COLD PLATE	1		GAEC	
-27	LDW 340-M10772-1 FRAME ASSY	1	AL	GAEC	
-29	LDW 340-M10773-1 FRAME ASSY	1	MAG ALLOY	GAEC	
-31	MIT 2004147-004 SOCKET HEAD BOLTS	14	CRES STEEL	MIT	MIT2004147-004
-33	MIT 2004147-002 SOCKET HEAD BOLT	6	CRES STEEL	MIT	MIT2004147-002
-35	NAS 1133 PAN HEAD BOLT	28	CRES STEEL	GAEC	
-37	INTERCONNECT WIRING HARNESS	1		MIT	MIT-137714
-39	MIT2004147-005-SOCKET HEAD BOLT	6	CRES STEEL	MIT	MIT2004147-005
-41	NASA 10 0400 - CLAMP	5		MIT	

REVISIONS

REVISION LETTER	ITEM NUMBER	ZONE	AUTHORITY	DESCRIPTION	REVISED DATE	EFF ON MODULE NUMBER	APPROVALS

21638 AUG 17

NOTES

1. THIS DOCUMENT SPECIFIES TECHNICAL REQUIREMENTS BETWEEN ALL PARTIES EFFECTED HEREIN
2. INTERPRET DRAWINGS IN ACCORDANCE WITH STANDARDS PRESCRIBED BY MIL-D-70327
3. SCREWS ATTACHING -11(LGC) TO -21, -25, & -27 ARE TO BE INSTALLED WITH SUFFICIENT TORQUE TO INSURE A PRELOAD OF 1100 LBS. PER BOLT (65-70 IN LBS)
4. SCREWS ATTACHING -13(CDU) TO -19, -23 & -29 ARE TO BE INSTALLED WITH SUFFICIENT TORQUE TO INSURE A PRELOAD OF 1100 LBS. PER BOLT (65-70 IN LBS)
5. SCREWS ATTACHING -15(PSA) TO -17 ARE TO BE INSTALLED WITH SUFFICIENT TORQUE TO INSURE A PRELOAD OF 750 LBS PER BOLT (20-25 IN LBS)
6. LID 390-10001 CONTROLS INTRA-SYSTEM WIRING AND INTERFACE CONNECTORS.
7. EACH DELIVERABLE ITEM WILL BE CONSIDERED ACCEPTABLE FOR PHYSICAL DIMENSIONS OF THE INTERFACE WHEN INSPECTED AND FOUND TO BE IN AGREEMENT WITH THE DIMENSIONS AS SPECIFIED ON THIS DWG. THIS INSPECTION MAY BE ACCOMPLISHED USING A GAEC SUPPLIED INSPECTION CHECKING FIXTURE. THE GAEC INSPECTION CHECKING FIXTURE WILL BE DESIGNED, FABRICATED AND DIMENSIONALLY CHECKABLE TO THIS ICD. ASSOCIATE CONTRACTORS SHALL VERIFY THAT THE INSPECTION CHECKING FIXTURE IS IN AGREEMENT WITH THIS ICD AS A CONDITION OF ACCEPTANCE FOR USE AT THEIR FACILITY. GAEC WILL MAKE AVAILABLE MASTER TOOLING AND/OR GAUGES TO ASSOCIATE CONTRACTORS IF REQUESTED.
8. SURFACES A B & C MUST RETAIN FLATNESS TO WITHIN .010 TOTAL INDICATOR READING PER FOOT.
9. ALL DIMENSIONS ARE IN INCHES DECIMAL TOLERANCES UNLESS OTHERWISE NOTED; 2 PLACES ±.03; 3 PLACES ±.010 ANGULAR ±1/2°
10. BONDING DC RESISTANCE ACROSS METALLIC SURFACES SHALL BE 10 MILLIOHMS OR LESS. PROTECTION OF THESE SURFACES SHALL BE TEMPORARILY PROTECTED BY APPLYING A COAT OF MIL-C-16173 GRADE 4 CORROSION COMPOUND. ALUMINUM SURFACES TREATED PER MIL-C-5541 WITH ALODINE 1200S NEEDS NO PROTECTION.
11. ELECTRICAL CONNECTORS ARE DESIGNATED ON ICD *LID-390-10001
12. THERMAL INTERFACE MATL REQD BETWEEN LGC, CDU & PSA & COLD PLATES. MATL. TO BE SUPPLIED BY GAEC. DESIGN DATA REQD
13. PART NO'S SHOWN FOR REFERENCE ONLY
14. THE DC RESISTANCE BETWEEN THE BOLTED CONNECTOR HALF & THE VEHICLE STRUCTURE SHALL BE LESS THAN 100 MILLIOHMS.
15. MATERIALS & FINISHES AT INTERFACES
    - LGC - MIT - AT COLDPLATE SURFACE - ELECTROLESS NICKEL PLATED PER ND1002198
      GAEC - 6951 AL ALLOY COLD PLATE - ALODINE 1200S FINISH - COAT WITH THERMAL INTERFACE MATL.
    - CDU - MIT - AT COLD PLATE SURFACE - MAGNESIUM ALLOY HK 31A-H24 PER MIL-M-26075. ANODIZED PER MIL-M-45202 TYPE I CLASS C.
      GAEC - 6951 AL. ALLOY COLD PLATE. - ALODINE 1200S FINISH - COAT WITH THERMAL INTERFACE MATL.
    - PSA - MIT - AT COLD PLATE SURFACE - MAGNESIUM ALLOY HK 31A-H24 PER MIL M-26075 ANODIZED PER MIL-M-45202, TYPE I, CLASS C.
      GAEC - 6951 AL. ALLOY COLD PLATE. - ALODINE 1200S FINISH - COAT WITH THERMAL INTERFACE MATL.
    - FILTER ASSY - MIT - AT INTERFACE - MAGNESIUM ALLOY AZ31B-H24 ANODIZED PER MIL-M-45202, TYPE I, CLASS C
      GAEC - 2024 AL ALLOY BRACKET - ALODINE 1200S FINISH.
16. EFFECTIVITY; LTA 1, 3, 4, 5, & 8
    LEM *1 THRU *11

DRAWN BY	E PETERSON	
LAYOUT BY		
DSGN PROV		
SE PROJ		
GAEC		
GAEC		
MIT	J. Hoag	

GRUMMAN AIRCRAFT ENGRG. CORP
BETHPAGE L. I. N. Y.

INTERFACE CONTROL DOCUMENT
PGNS (LGC-CDU-PSA & SIGNAL CONDITIONER)

CONTRACT NO. NAS 9-1100

CODE IDENT NO. 26512 | SIZE | LID-340-1000

SCALE | LINE ITEM | SHEET

E-4 LID 34010000

REV

ICD NO LIS-520-10001

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
BETHPAGE, L. I., NEW YORK

INTERFACE CONTROL DOCUMENT

TDRR 21638 AUG 17 1965

THIS DOCUMENT SPECIFIES TECHNICAL REQUIREMENTS BETWEEN ALL PARTIES AFFECTED HEREIN. NOTHING CONTAINED IN THIS DOCUMENT SHALL BE DEEMED TO ALTER THE TERMS OF ANY CONTRACT OR PURCHASE ORDER BETWEEN GAEC AND THE ADDRESSEE.

APPROVALS

AUTHORIZED SIGNATURES	REPRESENTING	DATE
A B Whitaker	GAEC	6/21/65
C L Gardner	GAEC	6/22/65
D. G. Hoag	MIT	22 Jul 65

PREPARED BY: J. Bura JB CHECKED: R. Hilderman sh

TITLE:

LEM DESIGN ENVIRONMENT

CCA NO.

REV	MODEL NUMBER	REV	MODEL NUMBER	REV	MODEL NUMBER

EFFECTIVITY

CODE IDENT NO.	SHEET	ICD NO.	REV
26512	SHEET 1 OF 18	LIS-520-10001 JUL 27 1965	

INTERFACE CONTROL DOCUMENT

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
BETHPAGE, L. I., NEW YORK

REVISIONS

REV LTR	IRN NO.	SHEET	DESCRIPTION – INCLUDE CCA NUMBER	REV. BY	APPROVALS		DATE
					GAEC		

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
BETHPAGE, L. I., NEW YORK

This document covers the LEM induced environmental conditions for the navigation and guidance equipment supplied by MIT and installed in the LEM. The units and general location are:

1. IMU - Inertial Measuring Unit)Between heat shield
2. NVB - Navigation Base)and crew cabin
3. PTA - Pulse Torque Assembly)
4. Wiring Harness "P")
5. AOT - Alignment Optical Telescope)From inside cabin to outside of heat shield
6. DSKY - Display and Keyboard)
7. LGC - LEM Guidance Computer) Crew
8. PSA/SCA - Power Servo Assembly/Signal Conditioning Assembly) Cabin
9. CDU - Coupling Data Units)
10. Wiring Harness "A")

The environmental conditions specified herein apply to the LEM mission phases as tabulated below. In any mission phase, various types of environments (A, B, C, etc.) can occur simultaneously as listed.

Mission Phases*

	Launch & Boost	Space Flight Translunar	Lunar Descent	Lunar Stay	Lunar Ascent
Acceleration	A-1 or A-5	A-3 or A-5	A-2 or A-5	A-6	A-4 or A-5
Shock		B-1	B-2, B-3		B-4
Vibration	C-1		C-2		C-2
Pressure	D-1, D-5, D-7	D-2, D-6, D-8	D-3, D-6, D-9	D-4, D-6, D-9	D-3, D-6, D-9
Humidity	F-1	F-2	F-3	F-3	F-3
Meteoroids	G	G	G	G	G
Acoustics	I				

*1. Launch and boost includes launch from earth, earth parking orbit, and burning time for translunar injection.

2. Space Flight - Translunar begins after translunar injection and includes transposition, retro into lunar orbit, and lunar orbit.

3. Lunar descent includes separation, descent, hover and touchdown.

4. Lunar ascent includes ascent, rendezvous and docking.

5. A-1, B-1, etc. refer to the paragraphs in the text.

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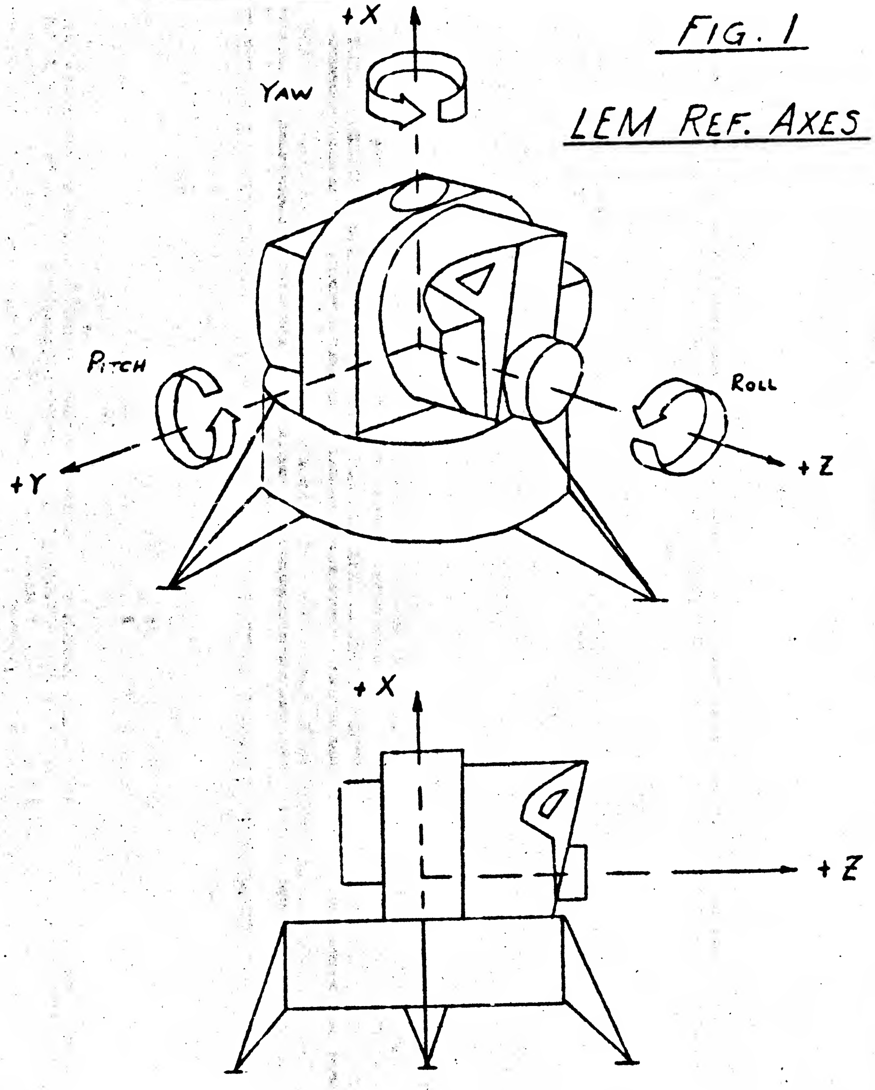
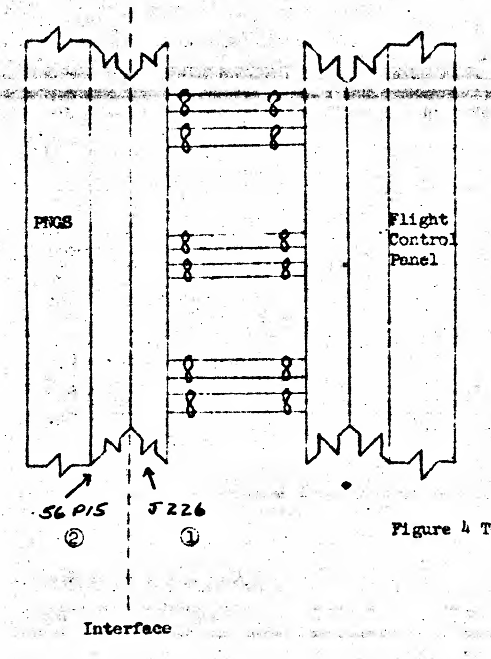


FIG. 1

LEM REF. AXES

IRN No. LIS 350-10001-0
PAGE 5 OF 8



Connector Identification		Signal Identification
PIN	Wire Gauge	
[illegible]		[illegible]
13		Sin Aig - Sine Inner Gimbal Angle - Low
3		Cos Aig - Cosine Inner Gimbal Angle
10		Cos Aig - Cosine Inner Gimbal Angle - Low
8		Sin Amg - Sine Middle Gimbal Angle
9		Sin Amg - Sine Middle Gimbal Angle - Low
7		Cos Amg - Cosine Middle Gimbal Angle
18		Cos Amg - Cosine Middle Gimbal Angle - Low
16		Sin Aog - Sine Outer Gimbal Angle
17		Sin Aog - Sine Outer Gimbal Angle - Low
5		Cos Aog - Cosine Outer Gimbal Angle
14		Cos Aog - Cosine Outer Gimbal Angle - Low

NOTE: Connector types are defined in LIS-390-10001.

Figure 4 Total Attitude Signals

INTERFACE CONTROL DOCUMENT

SHEET OF

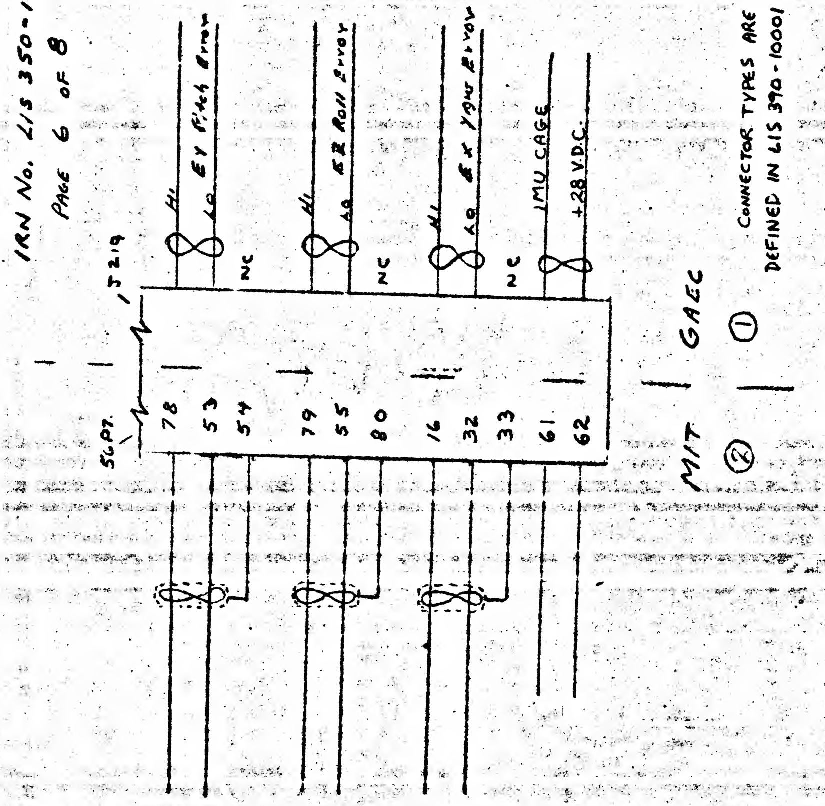
ICD NO. [redacted]

REV

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
BETHPAGE, L. I., NEW YORK

ENG 37.3 1-64

IRN No. LIS 350-10001-01
PAGE 6 OF 8



CONNECTOR TYPES ARE DEFINED IN LIS 390-10001

FIG. 6

ATTITUDE ERROR INTERFACE WIRING

AUTHORIZED SIGNATURES	REPRESENTING	DATE	INTERFACE REVISION NOTICE INTERFACE CONTROL DOCUMENT	CODE IDENT NO.	IRN NO:
	GAEC			26512	ICRA NO:
				ICD NO.	
			GRUMMAN AIRCRAFT ENGINEERING CORPORATION BETHPAGE, L. I., NEW YORK	CCA NO.	DATE
				ICD TITLE	

THIS DOCUMENT SPECIFIES TECHNICAL REQUIREMENTS BETWEEN ALL PARTIES AFFECTED HEREIN. NOTHING CONTAINED IN THIS DOCUMENT SHALL BE DEEMED TO ALTER THE TERMS OF ANY CONTRACT OR PURCHASE ORDER BETWEEN GAEC AND THE ADDRESSEE.

DESCRIPTION:

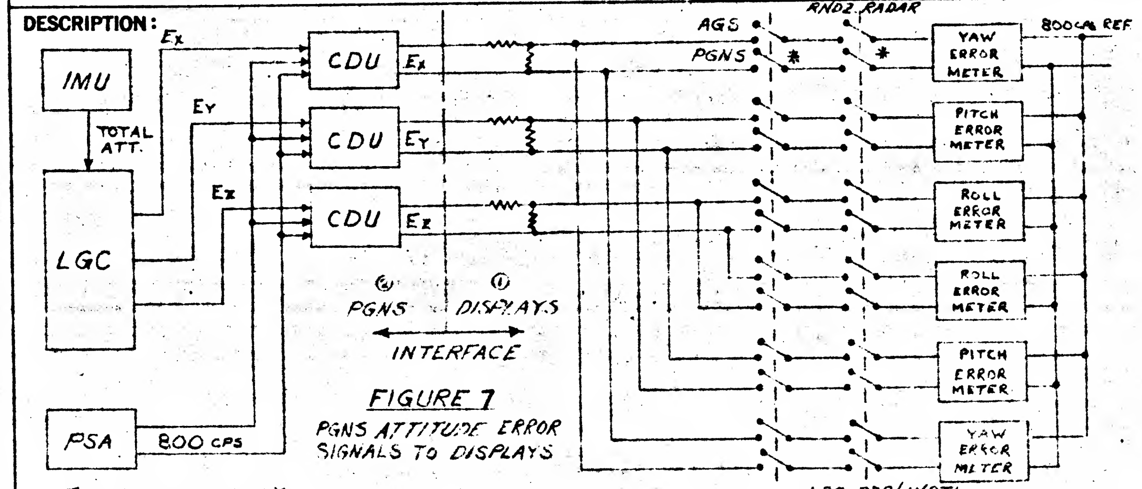


FIGURE 7
PGNS ATTITUDE ERROR SIGNALS TO DISPLAYS

For Reference ONLY

REASON:

DRAWN BY: P. Wiley

ENG 37.3 1-64

IRN No. LIS 350-10001-01
PAGE 7 OF 8

IRN No. LIS 350-10001-01
PAGE 8 OF 8

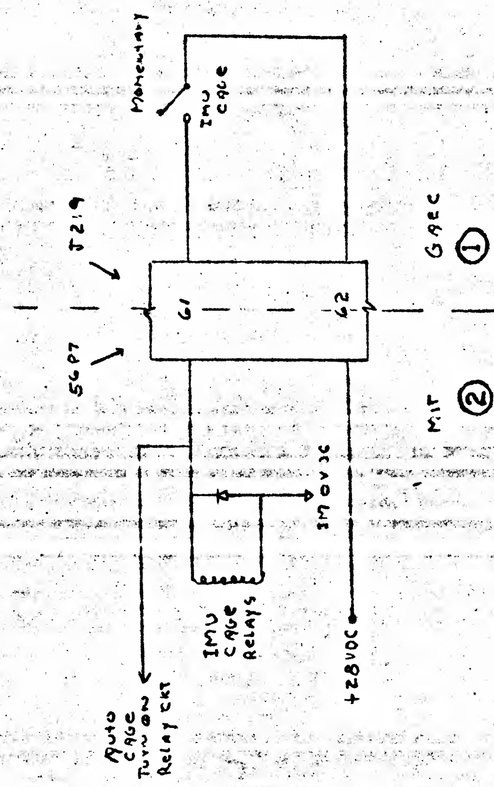
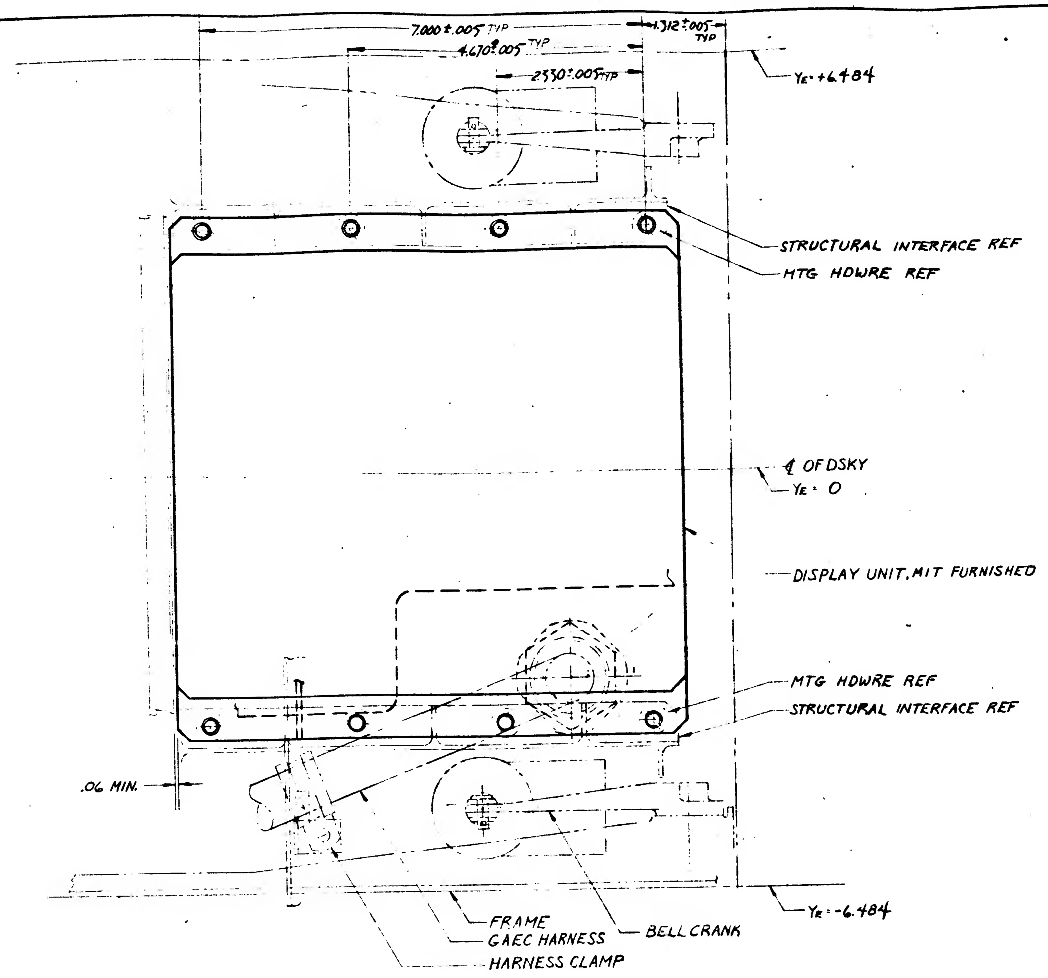


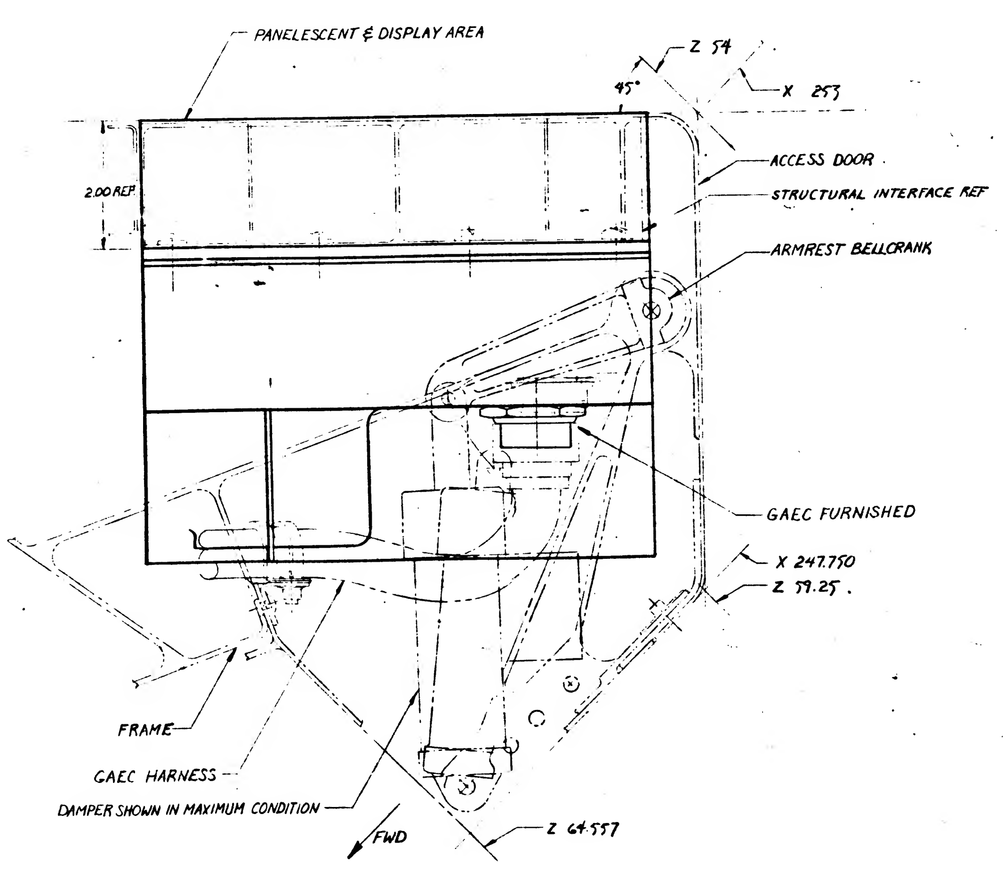
FIG 8

IMU CAGE INTERFACE

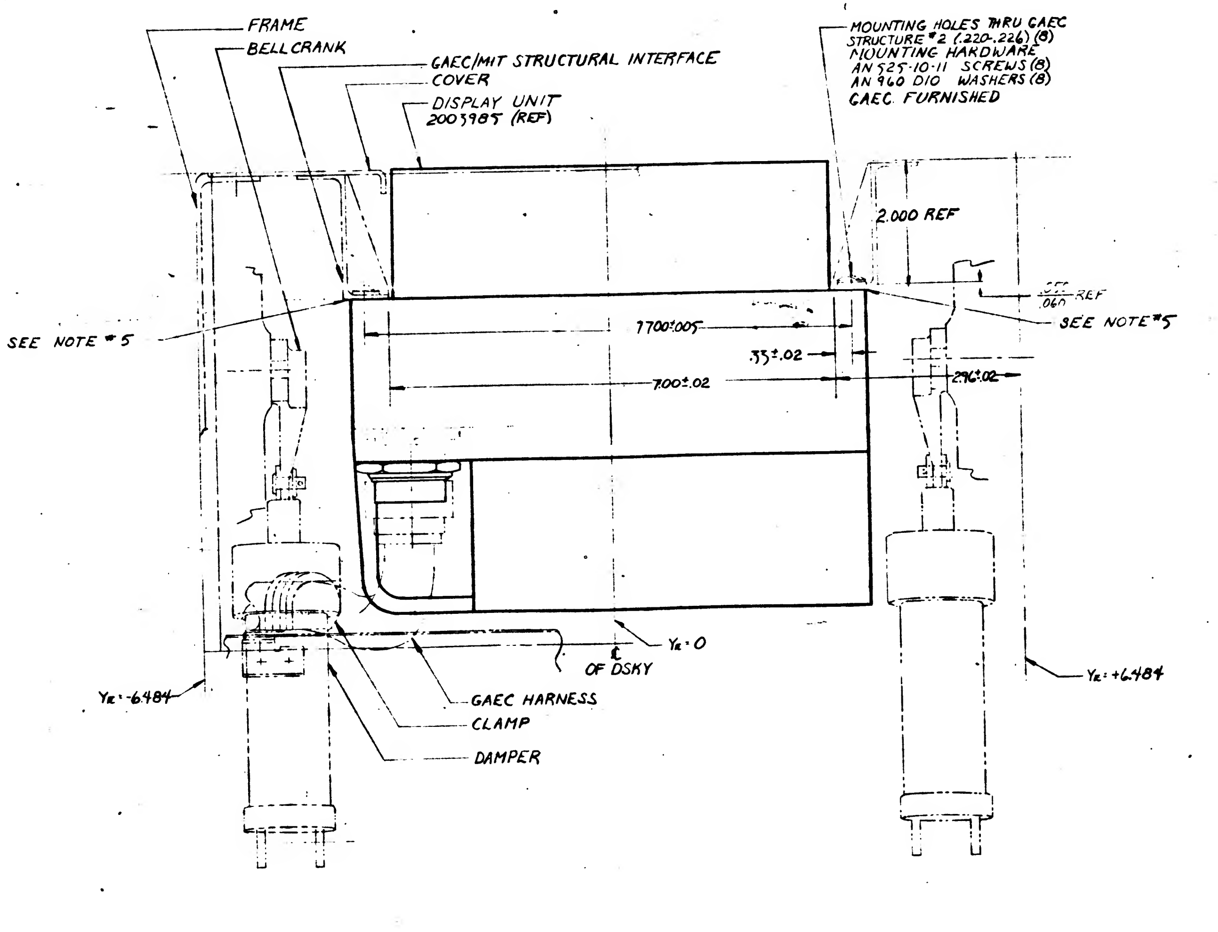
THIS FIGURE FOR REFERENCE ONLY



PLAN VIEW



VIEW LOOKING INBOARD @ YE -6.5



VIEW LOOKING FORWARD

NOTES -

1. THIS DOCUMENT SPECIFIES TECHNICAL REQUIREMENTS BETWEEN ALL PARTIES AFFECTED HEREIN.
2. ALL VISIBLE SURFACES TO BE FINISHED IN ACCORDANCE WITH LID480-10002 (REF)
3. ALL DIMENSIONS ARE IN INCHES. DECIMAL TOLERANCES UNLESS OTHERWISE NOTED; 2 PLACES ±.03, 3 PLACES ±.010, ANGULAR ±1°0'
4. INFORMATION SHOWN ON THIS RELEASE OF THIS I.C.D. SHALL BE CONSIDERED FINAL, EXCEPT THAT ADDITIONAL DETAIL WILL BE SHOWN ON SUBSEQUENT RELEASES IN ORDER TO FULFILL COMPLETE REQUIREMENTS OF THIS I.C.D.
5. BONDING DC RESISTANCE ACROSS METALLIC SURFACES SHALL BE 10 MILLIOHMS OR LESS. PROTECTION OF THESE SURFACES SHALL BE TEMPORARILY PROTECTED BY APPLYING A COAT OF MIL-C-16173 GRADE 4 CORROSION COMPOUND. ALUMINUM SURFACES TREATED PER MIL-C-5541 WITH ALODINE 1200S, NEEDS NO PROTECTION.
6. EACH DELIVERABLE ITEM WILL BE CONSIDERED ACCEPTABLE FOR PHYSICAL DIMENSIONS OF THE INTERFACE WHEN INSPECTED AND FOUND TO BE IN AGREEMENT WITH THE DIMENSIONS AS SPECIFIED ON THIS DRAWING. THIS INSPECTION MAY BE ACCOMPLISHED USING A GAEC SUPPLIED INSPECTION CHECKING FIXTURE. THE GAEC INSPECTION CHECKING FIXTURE WILL BE DESIGNED, FABRICATED, AND DIMENSIONALLY CHECKABLE TO THIS I.C.D. ASSOCIATE CONTRACTERS SHALL VERIFY THAT THE INSPECTION CHECKING FIXTURE IS IN AGREEMENT WITH THIS ICD AS A CONDITION OF ACCEPTANCE FOR USE AT THEIR FACILITY. GAEC WILL MAKE AVAILABLE MASTER TOOLING AND/OR GAUGES TO ASSOCIATE CONTRACTORS IF REQUESTED.
7. ALL PART NUMBERS SHOWN ARE FOR REFERENCE ONLY.
8. EFFECTIVITY: LTA 1,3,4,5,8 & LEM 1 THRU 11
9. PANEL COLORS TO CONFORM TO ICD MH 01-05174-414 & MH 01-01388-416.
10. MATERIAL AT INTERFACE IS:
    MIT: AL 6061-T6 PER QQ-A-250/11, ALODINED PER 1200S.
    GAEC: AL 7075-T6511/T651 PER QQ-A-277/282, ALODINED PER 1200 S.

1.2.2.3 **Coolant Pressure Drop:** The maximum pressure drop through the IMU cooling loop including both halves of the disconnects shall be between 0.3 psi and 0.4 psi at a coolant flow rate of 33 lb/hr and inlet temperature of 40°F.

1.2.2.4 **Coolant Temperature Variations:** The inlet coolant temperature variations for the IMU will vary from 32°F to 50°F.

1.2.3 **Cold Plate Cooling:**

1.2.3.1 **Coolant Flow Rate:** The LGC, CDU, and LPSA cold plates are connected in series in the ECS loop. Figure 2 shows the flow pattern of the coolant through the equipment cold plates. The flow rate to the LGC, CDU, and LPSA coolant loop will be 33±5 lb/hr. The flow rate to the PTA cold plate will be 33±5 lb/hr. The coolant flow pattern through the PTA cold plate is shown in Figure 2. During unmanned translunar flight, there will be no coolant flow to the PGNS equipment cold plates.

1.2.3.2 **Coolant Temperature Variations:** The inlet coolant temperature to the LGC, CDU, and LPSA coolant loop during manned phases of the mission will be 32°F to 50°F. The coolant inlet temperature to the PTA cold plate will be ④ ① ② .

1.2.3.3 **Interface Conductance:** For design purposes, the thermal gradient across the interface between the equipment heat sink surface and the environmental control coolant shall be assumed to be five (5)°F for every watt per square inch of power dissipated to the cold plates.

1.2.4 **Leakage Rate:** The maximum leakage from the integrally cooled G&N equipment shall be as specified herein.

1.2.4.1 **Integral Heat Exchangers:** The maximum allowable leakage for each MIT supplied heat exchanger, including all permanent joints and all seals, shall be 5×10^{-6} std. cc/sec. of helium at 77.5 psig.

1.2.4.2 **Disconnects:** The maximum leakage for each disconnect in the fully connected condition shall be 12×10^{-8} std. cc/sec. of helium at 77.5 psig.

1.2.5 **Passive Cooling:** The Display Panel and AOT must be capable of operating in the environments specified in 1.4.1, 1.4.2. In addition, the AOT must be capable of accepting a maximum heat load of 9 watts from the LEM Abort Sensor Assembly when the AOT is at 0°F.

1.3 **Surface Characteristics:** Equipment surfaces shall conform to the following requirements.

1.3.1 **Surface Temperatures:** The temperature of the external surfaces of actively cooled G & N equipment shall not exceed 120°F during any portion of the vehicle mission.

1.3.2 **Surface Coatings:** The surface coatings required for the actively and passively controlled G & N equipment are as follows:

1.3.2.1 **Actively Cooled Equipment:** External surfaces, with the exception of heat sink surfaces, of the LGC, CDU, LPSA and PTA shall have an infrared emittance of 0.40 or less in the region of the electromagnetic spectrum between 5 microns and 35 microns.

1.3.2.2 **Passively Cooled Equipment:** Surfaces of the display panel and the AOT exposed to the interior of the LEM vehicle shall have an infrared emittance of at least 0.9 in order to be compatible with the environment of 1.4.1.

1.4 **Thermal Environment:** The thermal interchange of the G&N equipment with the surroundings will be to the extent specified herein.

1.4.1 **Radiant Interchange with LEM Vehicle:** The temperature of the surfaces in radiant contact with the PGNS equipment will vary from 0°F to 130°F during unmanned translunar flight, and from 0°F to 160°F during manned phases of the mission.

1.4.2 **Conductive Interchange with the LEM Vehicle:** The LGC, CDU, LPSA, PTA and their cold plates will be conductively isolated from LEM structure. The conduction resistance between the IMU and its mounting structure shall be 1.4 °F/watt or greater. The temperature of the IMU mounting structure shall be 0°F to 130°F during unmanned translunar flight and 0 - 160°F during manned phases of the mission.

1.5 **Equipment Power Dissipation:** The maximum average power dissipation for the G & N equipment is as follows:

LGC	- 100 watts 10 watts	- Operate Mode - Standby Mode
CDU	- 68 watts	
LPSA	- 110 watts 18 watts	- IMU in Operate Mode - IMU in Standby Mode
PTA	- 79 watts	
Displays	- 19 watts	
AOT	- 15 watts	
IMU	- See Figure 3 AND 4	

FIGURE 4

SPECIFIC HEAT VS. TEMPERATURE
35% ETHYLENE GLYCOL
65% WATER

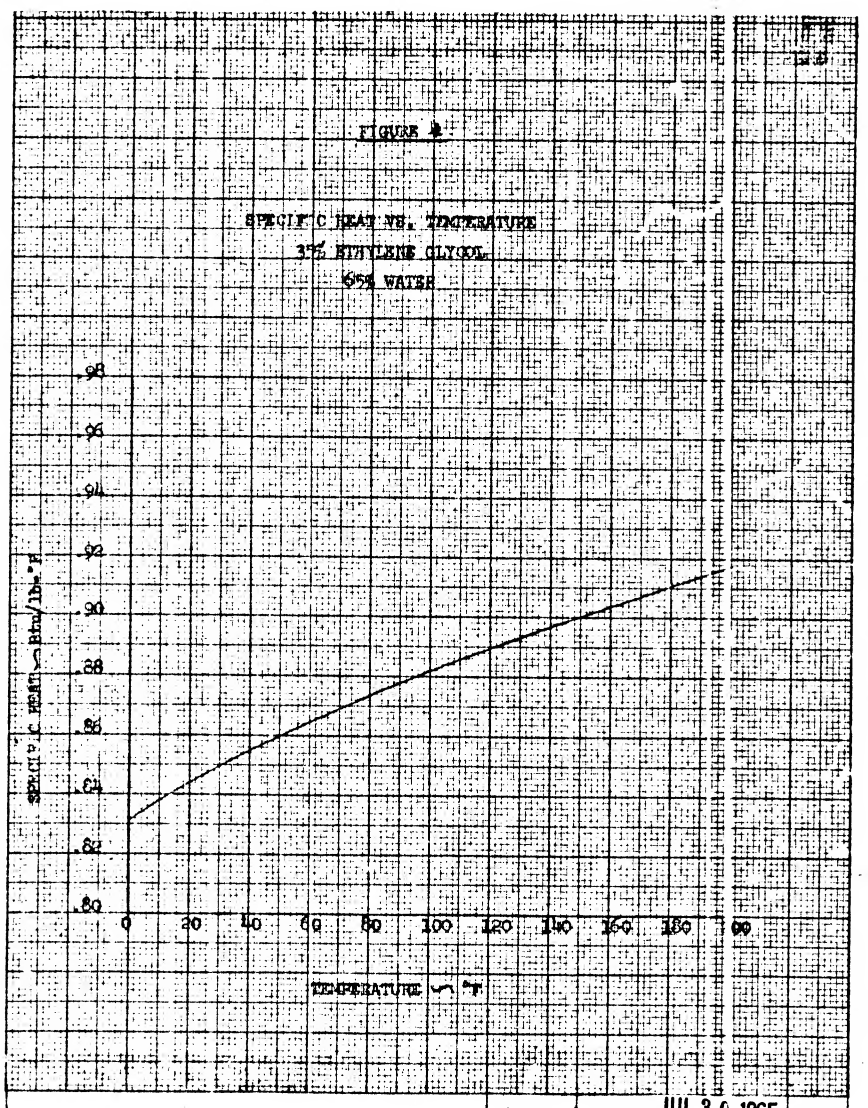
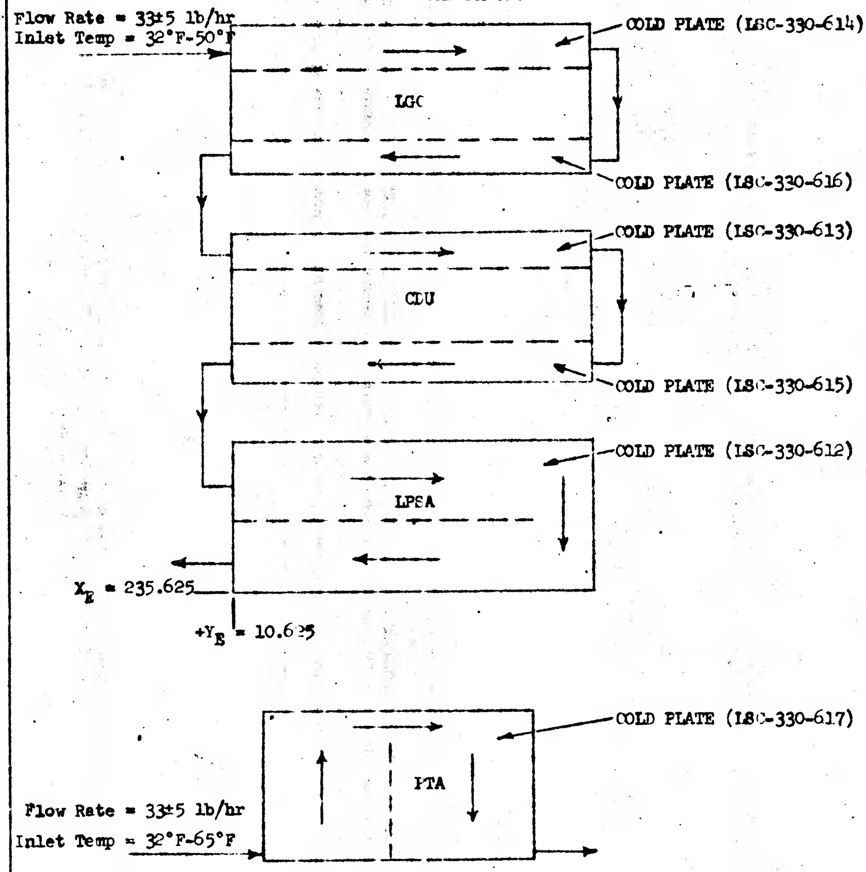
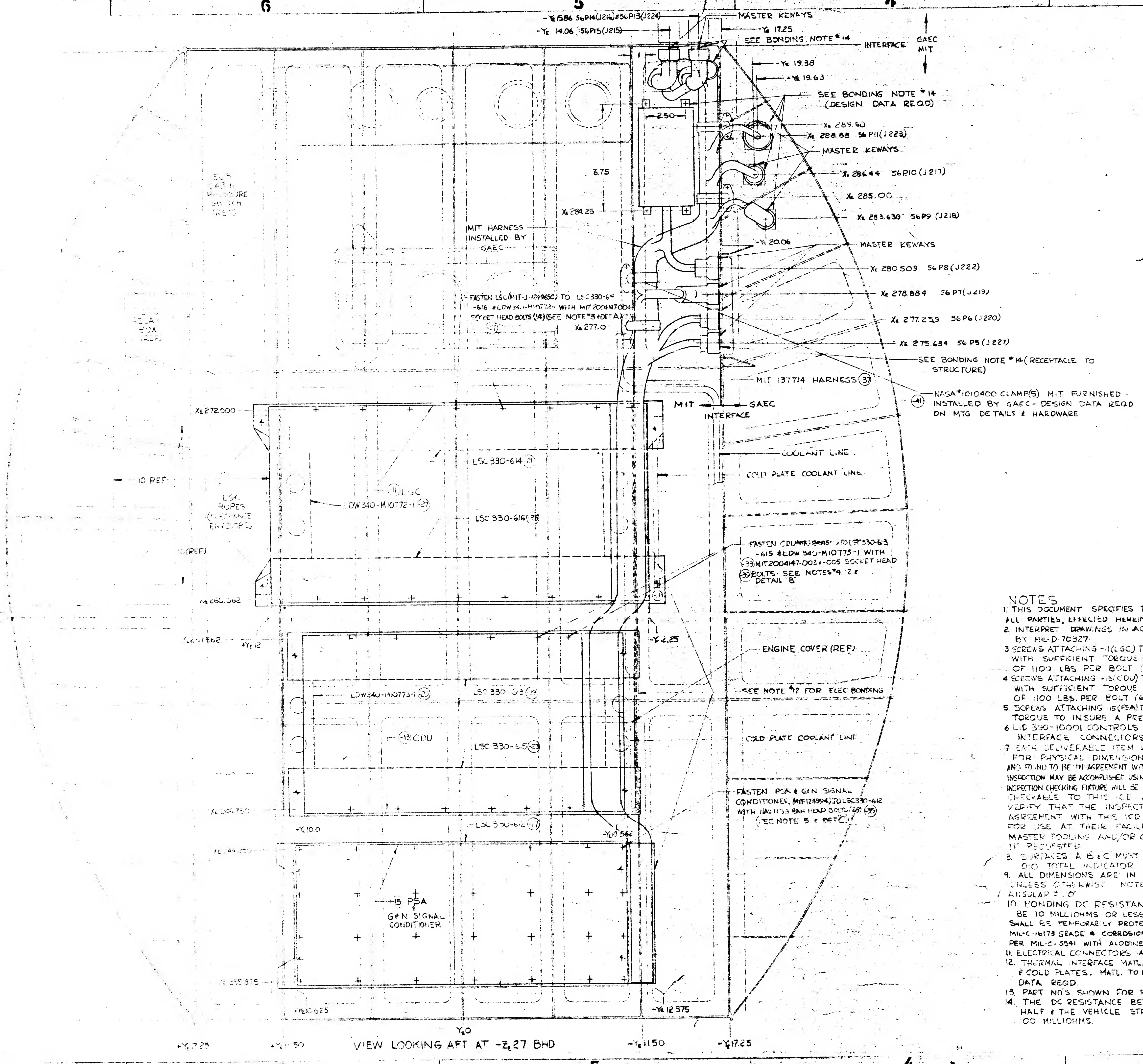


FIGURE 2

COOLANT FLOW PATTERNS
FOR LGC, CDU, LPSA AND PTA
COLD PLATES




6
5
4
3
2
-Y 15.86 56P14(J216) & 56P13(J224)
-Y 14.06 56P15(J215)
MASTER KEWAYS
-Y 17.25
SEE BONDING NOTE #14
INTERFACE
GAEC
MIT
-Y 19.38
-Y 19.63
SEE BONDING NOTE #14 (DESIGN DATA REQD)
2.50
X 289.50
X 288.88 56P11(J223)
MASTER KEWAYS
6.75
X 286.44 56P10 (J217)
X 285.00
X 284.25
X 283.630 56P9 (J218)
ECS CABIN PRESSURE SWITCH (REF)
MIT HARNESS INSTALLED BY GAEC
-Y 20.06
MASTER KEWAYS
X 280.509 56P8(J222)
X 278.884 56P7(J219)
FASTEN LGC (MIT-J-124965C) TO LSC330-614 -616 & LDW340-M10772-1 WITH MIT 2004147-004 SOCKET HEAD BOLTS (14) (SEE NOTE #3 & DET A) (31)
RELAY BOX (REF)
X 277.0
X 277.259 56P6(J220)
X 275.634 56P5(J227)
SEE BONDING NOTE #14 (RECEPTACLE TO STRUCTURE)
MIT 137714 HARNESS (37)
(41) NASA #1010400 CLAMP(5) MIT FURNISHED - INSTALLED BY GAEC - DESIGN DATA REQD ON MTG DETAILS & HARDWARE
X 272.000
MIT
GAEC
INTERFACE
COOLANT LINE
COLD PLATE COOLANT LINE
LSC 330-614 (21)
10 REF
(11) LGC
LGC ROPES (CLEARANCE ENVELOPE)
LDW340-M10772-1 (27)
LSC 330-616 (25)
10 (REF)
FASTEN CDU (MIT-J-124985C) TO LSC330-613 -615 & LDW 340-M10773-1 WITH (33) MIT 2004147-002 & -005 SOCKET HEAD (39) BOLTS. SEE NOTES #4 12 & DETAIL "B"
X 260.562
X 251.562
+Y 12
-Y 2.25
ENGINE COVER (REF)
LDW340-M10773-1 (29)
LSC 330-613 (19)
SEE NOTE #12 FOR ELEC BONDING
(13) CDU
LSC 330-615 (23)
COLD PLATE COOLANT LINE
FASTEN PSA & GEN SIGNAL CONDITIONER, (MIT-124994) TO LSC330-612 WITH NAS1153 PAN HEAD BOLTS (28) (35) (SEE NOTE 5 & DET C)
X 246.750
+Y 10.0
LSC 330-612 (17)
-Y 10.562
X 244.250
(15) PSA & GEN SIGNAL CONDITIONER
X 235.875
+Y 10.625
-Y 12.375
Y 0
+Y 17.25
+Y 11.50
VIEW LOOKING AFT AT -Z 27 BHD
-Y 11.50
-Y 17.25

LIST OF AFFECTED PARTS

DASH NO.	DESCRIPTION	NO REQD PER INSTL	MATERIAL	SUPPLIER	REMARKS
-11	LEM GUIDANCE COMPUTER (LGC)	1		MIT	MIT-J-124965C
-13	COUPLING DISPLAY UNIT (CDU)	1		MIT	MIT-J-124985C
-15	POWER SERVO ASSY (PSA)	1		MIT	MIT-124994
-17	LSC 330-612 COLD PLATE	1		GAEC	
-19	LSC 330-613 COLD PLATE	1		GAEC	
-21	LSC 330-614 COLD PLATE	1		GAEC	
-23	LSC 330-615 COLD PLATE	1		GAEC	
-25	LSC 330-616 COLD PLATE	1		GAEC	
-27	LDW 340-M10772-1 FRAME ASSY	1	AL	GAEC	
-29	LDW 340-M10773-1 FRAME ASSY	1	MAG ALLOY	GAEC	
-31	MIT 2004147-004 SOCKET HEAD BOLTS	14	CRES STEEL	MIT	MIT2004147-004
-33	MIT 2004147-002-SOCKET HEAD BOLT	6	CRES STEEL	MIT	MIT2004147-002
-35	NAS 1153 PAN HEAD BOLT	28	CRES STEEL	GAEC	
-37	INTERCONNECT WIRING HARNESS	1		MIT	MIT-137714
-39	MIT2004147-005-SOCKET HEAD BOLT	6	CRES STEEL	MIT	MIT2004147-005
-41	NASA 1010400 - CLAMP	5		MIT	

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4. SCREWS ATTACHING -13(CDU) TO -19, 23 & -29 ARE TO BE INSTALLED WITH SUFFICIENT TORQUE TO INSURE A PRELOAD OF 1100 LBS. PER BOLT (65-70 IN LBS)
5. SCREWS ATTACHING -15(PSA) TO -17 ARE TO BE INSTALLED WITH SUFFICIENT TORQUE TO INSURE A PRELOAD OF 750 LBS PER BOLT (20-25 IN LBS)
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7. EACH DELIVERABLE ITEM WILL BE CONSIDERED ACCEPTABLE FOR PHYSICAL DIMENSIONS OF THE INTERFACE WHEN INSPECTED AND FOUND TO BE IN AGREEMENT WITH THE DIMENSIONS AS SPECIFIED ON THIS DWG THIS INSPECTION MAY BE ACCOMPLISHED USING A GAEC SUPPLIED INSPECTION CHECKING FIXTURE. THE GAEC INSPECTION CHECKING FIXTURE WILL BE DESIGNED, FABRICATED AND DIMENSIONALLY CHECKABLE TO THIS ICD. ASSOCIATE CONTRACTORS SHALL VERIFY THAT THE INSPECTION CHECKING FIXTURE IS IN AGREEMENT WITH THIS ICD AS A CONDITION OF ACCEPTANCE FOR USE AT THEIR FACILITY. GAEC WILL MAKE AVAILABLE MASTER TOOLING AND/OR GAUGES TO ASSOCIATE CONTRACTORS IF REQUESTED
8. SURFACES A, B & C MUST RETAIN FLATNESS TO WITHIN .010 TOTAL INDICATOR READING PER FOOT.
9. ALL DIMENSIONS ARE IN INCHES DECIMAL TOLERANCES UNLESS OTHERWISE NOTED, 2 PLACES ±.03; 3 PLACES ±.010 ANGULAR ± [illegible]0'
10. BONDING DC RESISTANCE ACROSS METALLIC SURFACES SHALL BE 10 MILLIOHMS OR LESS. PROTECTION OF THESE SURFACES SHALL BE TEMPORARILY PROTECTED BY APPLYING A COAT OF MIL-C-16173 GRADE 4 CORROSION COMPOUND. ALUMINUM SURFACES TREATED PER MIL-C-5541 WITH ALODINE 1200S NEEDS NO PROTECTION.
11. ELECTRICAL CONNECTORS ARE DESIGNATED ON ICD # LID-390-10001
12. THERMAL INTERFACE MATL. REQD BETWEEN LGC, CDU & PSA & COLD PLATES. MATL. TO BE SUPPLIED BY GAEC. DESIGN DATA REQD.
13. PART NO'S SHOWN FOR REFERENCE ONLY
14. THE DC RESISTANCE BETWEEN THE BOLTED CONNECTOR HALF & THE VEHICLE STRUCTURE SHALL BE LESS THAN [illegible]00 MILLIOHMS.
15. MATERIALS & FINISHES AT INTERFACES
    - LGC- MIT- AT COLDPLATE SURFACE - ELECTR
      NICKEL PLATED PER ND 302198;
      GAEC- 6951 AL ALLOY COLD PLATE- AL
      FINISH- COAT WITH THERMAL INTER
    - CDU - MIT- AT COLD PLATE SURFACE - MAGNES
      MK 31A-H24 PER MIL-M-26075 ANODIZ
      MIL-M-45202 TYPE I CLASS C.
      GAEC- 6951 AL. ALLOY COLD PLATE.-
      FINISH-COAT WITH THERMAL INTERFACE
    - PSA - MIT- AT COLD PLATE SURFACE MAGNESIUM
      HK 31A-H24 PER MIL-M-26075 ANODIZ
      MIL-M-45202, TYPE I, CLASS C.
      GAEC- 6951 AL. ALLOY COLD PLATE.-
      FINISH- COAT WITH THERMAL INTERFACE
    - FILTER ASSY- MIT- AT INTERFACE - MAGNESIUM ALLOY
      ANODIZED PER MIL-M-45202, TYPE I
      GAEC- 2024 AL ALLOY BRACKET ALOD
16. EFFECTIVITY, LTA 1, 3, 5, & 8
    LEM #1 THRU #11

A. Acceleration - (For combined environments see Sheet 3)

	X g	X Rad/Sec²	Y g	Y Rad/Sec²	Z g	Z Rad/Sec²
1) (Envelope of max. values) (See Fig. 6 for time history)	+4.9 -1.7	-	±.40	-	+.4	-
2)	+.82	±.19	±.08	±.65	±.8	±.65
3)(*See Note 1 Below)	-.36	-	±.062	±1.99	±.062	±1.99
4)	+.70	±.74	±.04	±.83	±.0	±1.47

5) Zero "g" condition. (No rotational or translational acceleration about any axis)

6) 1/6 "g" condition. (Vehicle at rest on lunar surface).

* NOTE 1 - Assume constant for duration of 6 minutes for translational accelerations.

Rotational accelerations in A-2, A-3, A-4 are due to RCS engine operation which is intermittent.

B. Shock (Applied at C.G. of any item of equipment)

For the transposition condition during translunar space flight, the following accelerations shall apply along each of three mutually perpendicular axes.

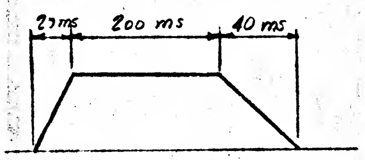
1)

	X g	X RAD/SEC²	Y g	Y RAD/SEC²	Z g	Z RAD/SEC²
(Preliminary)	-.052	-	±.065	±.10	±.065	±.10

Time history to be supplied when available.

2) For the lunar descent phase, use 20 ms rise time, ramp step shock. Four design cases occur during landing. These values are based on a rigid LEM with flexible landing gear and contain a 1.6 magnification factor.

	X g	X RAD/SEC²	Y g	Y RAD/SEC²	Z g	Z RAD/SEC²
Case 1	+8.0					±14.0
Case 2			±8.0			±14.0
Case 3				±14.0	±8.0	
Case 4	+8.0			±14.0		



RAMP STEP SHOCK

3) For the panel mounted equipment only, use 15g sawtooth pulse 10 ± 1 ms rise, 1 ± 1 ms decay.

4) Docking Condition and Time History to be supplied when available.

C. Vibration

The applied vibration environment is generated by rocket engine operation and structural response to acoustic excitation originating in boundary layer turbulence. It consists of broad band random excitation up to 2000 cps. Estimates have been made and mission level envelopes are presented for the launch vehicle operation, service propulsion system and LEM engine excitation. The high acceleration density levels at low frequencies are presented for use in design analysis only since available test equipment is incapable of reproducing the complete spectrum. The test equivalents given below include separate sinusoidal vibrations to account for the low frequency portion of the design spectrum as well as to determine the design adequacy in individual vibration modes.

At a given frequency, the power spectral density levels represent the 95% probability level anticipated over many missions. The total mean square vibration level for any given mission is expected to be approximately 1/5 of that determined by integrating the levels given below.

The vibrations given are applied by the LEM primary structure including panels to the N & G equipment supports along each of the three mutually perpendicular axes, X, Y, and Z.

GAEC qualification is to levels higher than these since factors of safety are not included.

ENVELOPES OF POWER SPECTRAL DENSITY (P.S.D.) LEVELS

Phase

C-1

Input to Equipment Supports From Exterior Primary Structure
(Use for IMU, AOT, DSKY, NVB, PTA, Wiring harness "B")

Random - 5 Min/Axis	
10-23 cps	12 db/octave rise to
23-80 cps	.0148 g²/cps
80-110 cps	12 db/Octave rise to
110-950 cps	.0444 g²/cps
950-1200 cps	12 db/octave rolloff to
1200-2000 cps	.0143 g²/cps

Sinusoidal - 3 Oct/Min.	
5-13.5 cps	0.154"D.A.
13.5-100 cps	2.69 g

Input to Equipment Supports from Interior Primary Structure
(Use for LGC, CDU, PSA/SCA, & Wiring Harness "A")

Random - 5 Min/Axis	
10-23 cps	12 db/octave rise to
23-80 cps	.0148 g²/cps
80-100 cps	12 db/octave rise to
100-1000 cps	.0355 g²/cps
1000-1200 cps	12 db/octave rolloff to
1200-2000 cps	.0148 g²/cps

Sinusoidal ⅓ Oct/Min.	
5-16 cps	.154" D.A.
16-100 cps	1.92 g

C-2

(Prelaunch Design Time Equals 75 sec)

Input to Ascent Stage Equipment
(Use for all Equipment)

Random 21 Min/Axis	
10-20 cps	12 db/oct rise to
20-100 cps	.0201 g²/cps
100-120 cps	12 db/oct rolloff to
120-2000 cps	.010 g²/cps

Sinusoidal ⅓ Oct/Min.	
5-17 cps	.10" D.A.
17-100 cps	1.54 g

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During the launch and boost phase of flight the LEM is exposed to random vibration of varied levels and spectra for 17 minutes. During all but approximately 2.5 minutes of this period, the intensity of the random vibration is of such a low level that it is considered to be of negligible design significance. In addition, the launch and boost environment is considered to include peak vibration levels which are represented by the above sinusoidal vibration envelopes. The number of sinusoidal peaks for design may be considered to be 1 percent of the natural frequency of the equipment and its supporting structure times the number of seconds exposure. For design purposes, the above random spectrum and sinusoidal levels applied separately for 5 minutes along each of the three mutually perpendicular axes X, Y and Z are considered to adequately represent the vibration environment. Grumman will supply the influence coefficients of the navigation base supporting the IMU. All other equipment is effectively mounted on primary structure.

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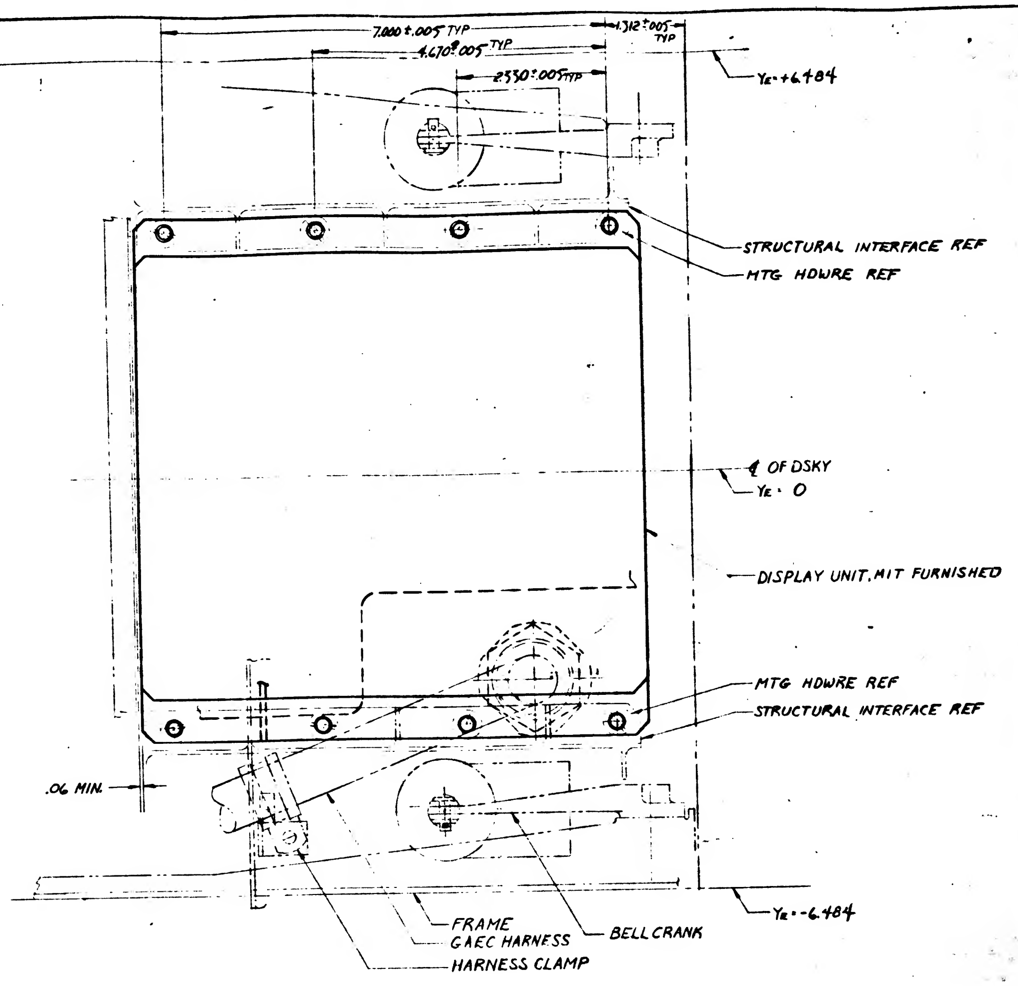
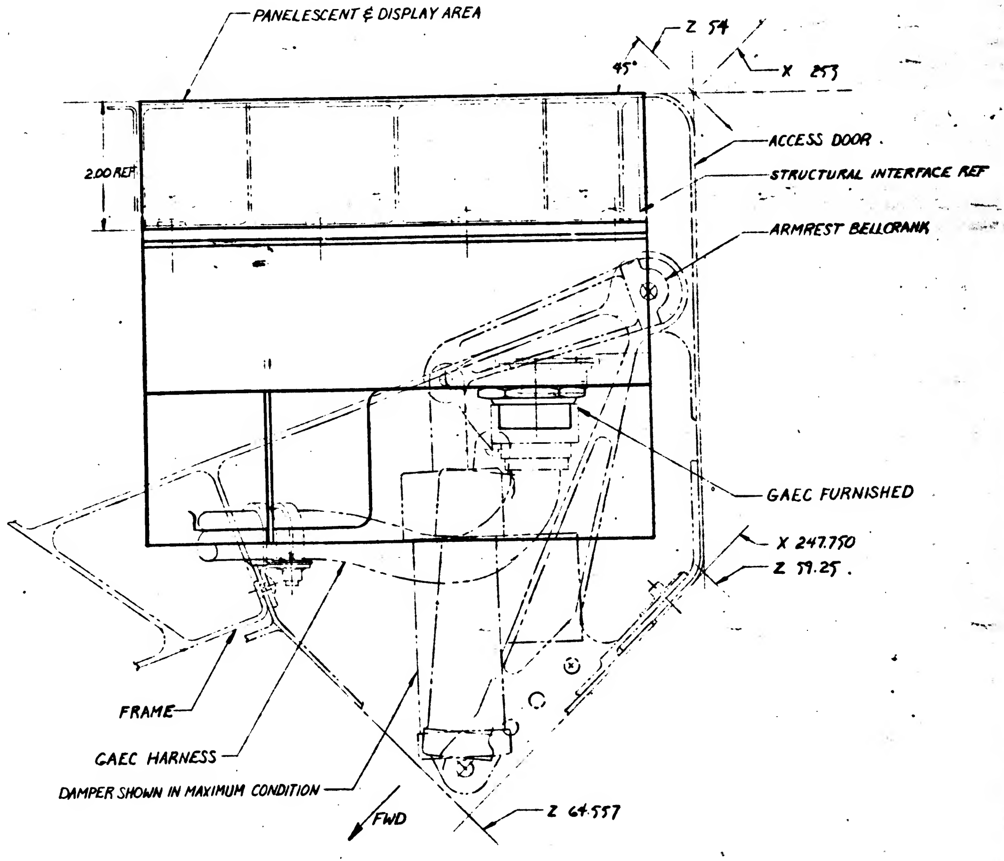
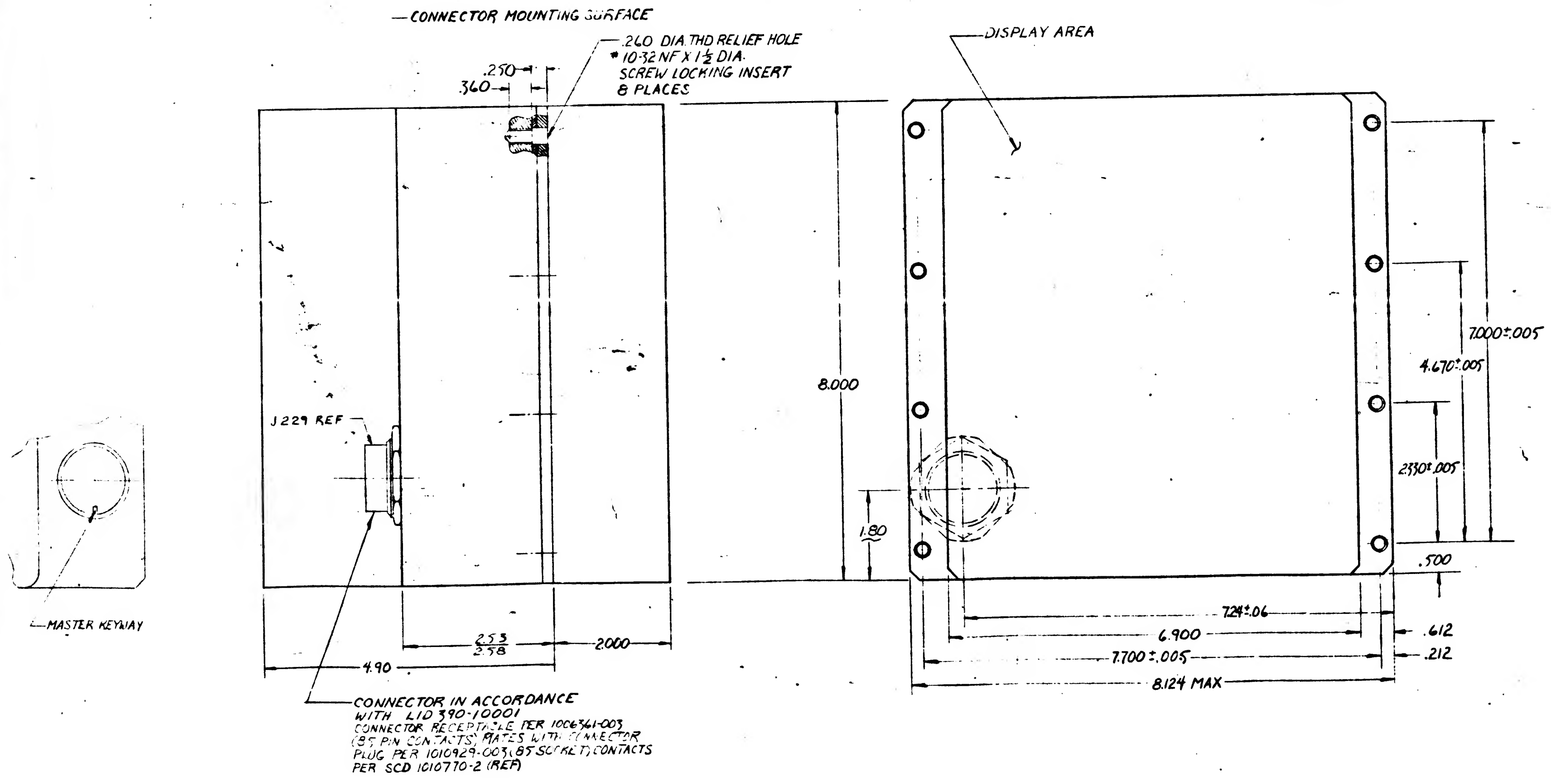


PLAN VIEW



VIEW LOOKING INBOARD @ YE=-6.5



MIT KEYBOARD DISPLAY

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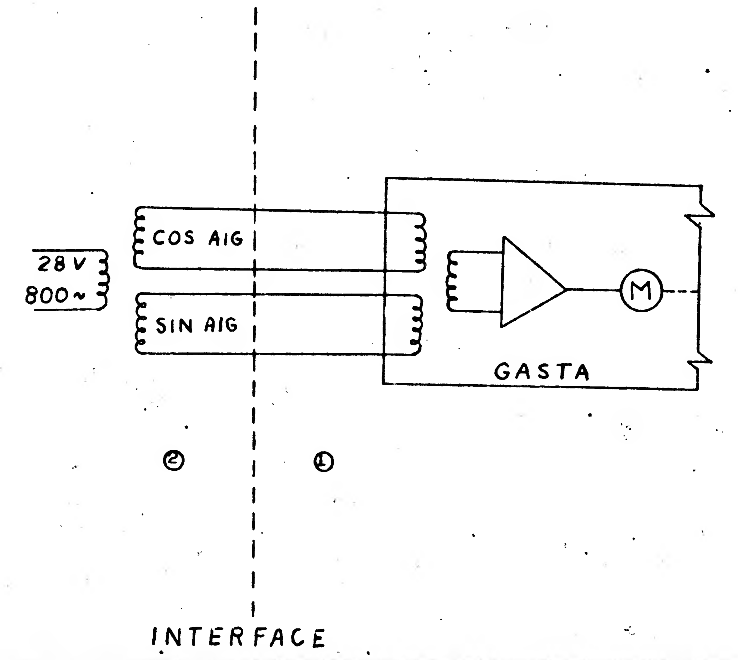
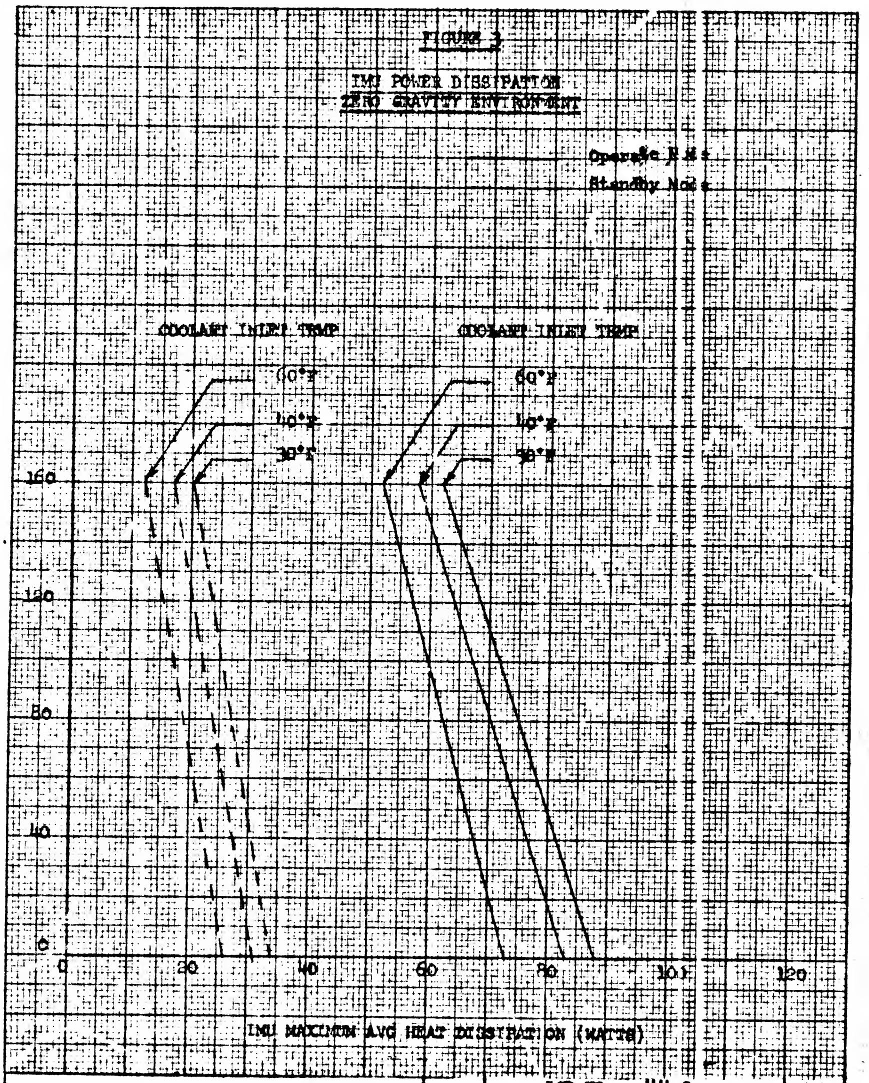


Inner Gimbal Axis shown, Middle and Outer Gimbal Axes are identical.

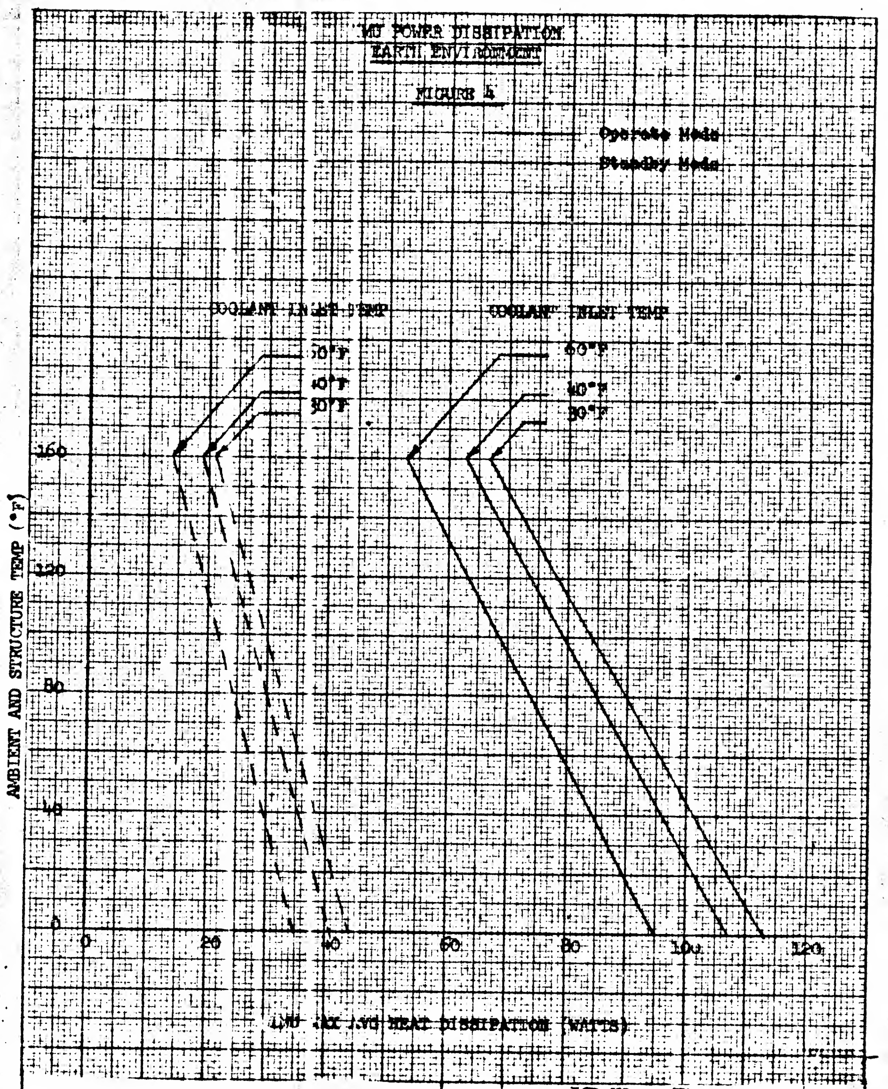
Figure 5 Interface Schematic

INTERFACE CONTROL DOCUMENT	SHEET 9 OF 9	ICD NO. LIB-350-10001	REV



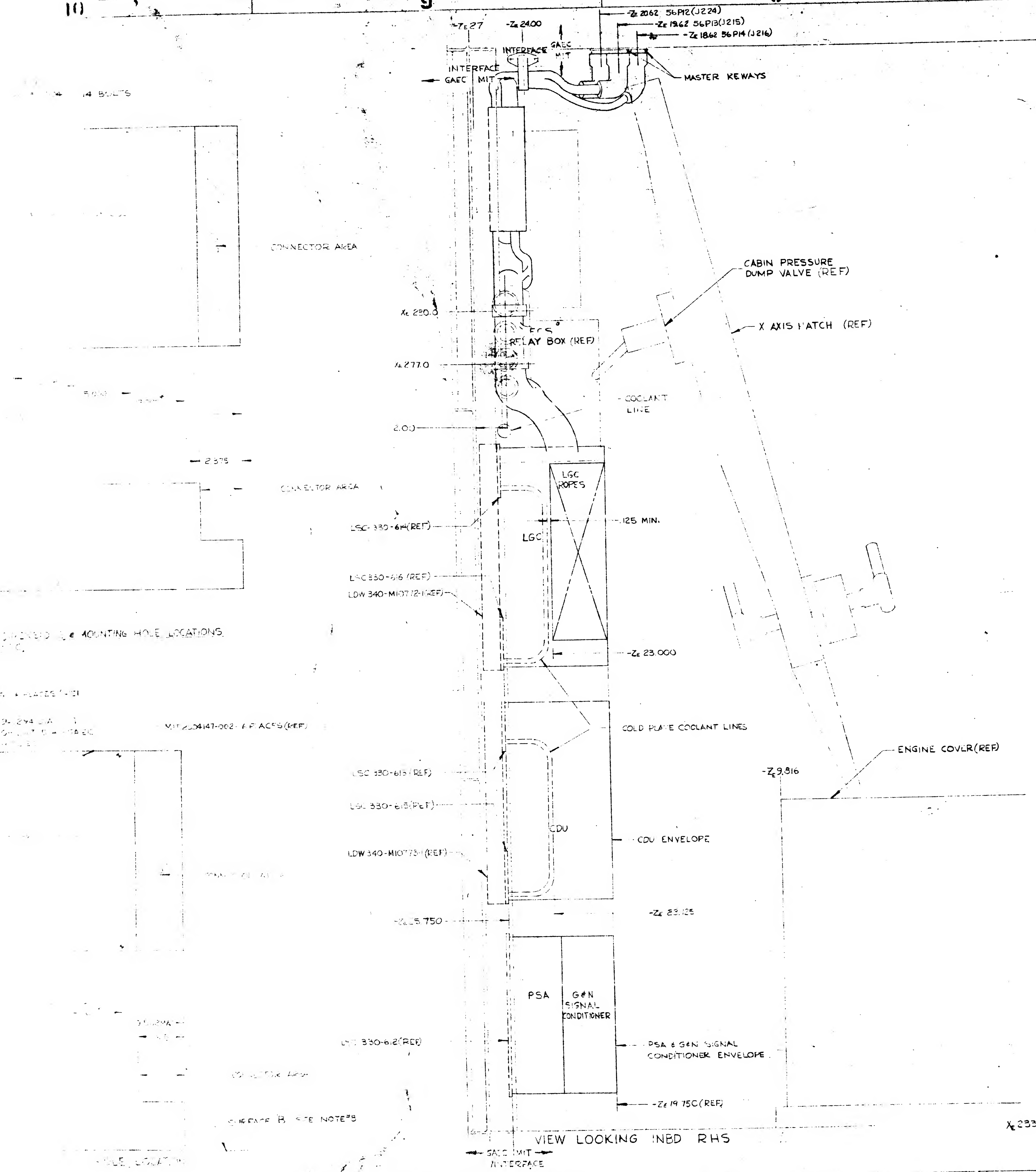
INTERFACE CONTROL DOCUMENT	SHT 9 of 10	ICD NO. LIS-510-10001 JUL 3 0 1965	REV A

K+E 10 X 10 TO THE ½ INCH 359T-11 KEUFFEL & ESSER CO. ALBANENE ® MADE IN U.S.A.

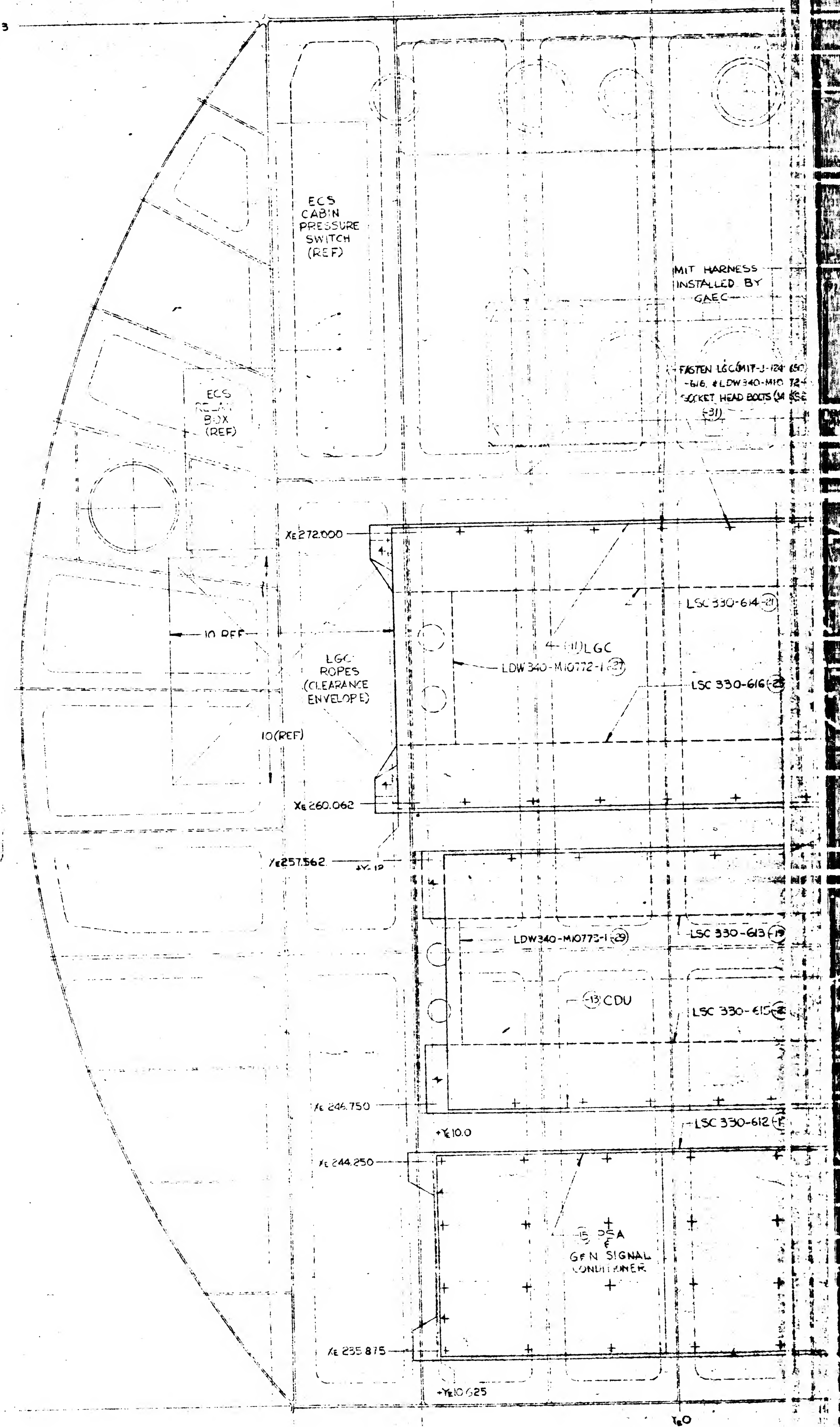


INTERFACE CONTROL DOCUMENT	SHT 10 of 10	ICD NO. LIS-510-10001 JUL 3 0 1965	A

K+E 10 X 10 TO THE ½ INCH 359T-11 KEUFFEL & ESSER CO. ALBANENE ® MADE IN U.S.A.



VIEW LOOKING INBD RHS



VIEW LOOKING AFT AT -Z_E 27 BHD

Test Equivalent of Power Spectral Density (P.S.D.) Levels

Phase

C-1

Input to Equipment Supports From Exterior Primary Structure
(Use for IMU, NVB, AOT, PTA, DSKY, & Wiring Harness "B")

Random	5 Min./Axis	Sinusoidal -	3 oct/min. 1 sweep from 5 CPS to 2000 CPS to 5 CPS
10-23 CPS	12 db/oct rise to	5-18.5 CPS	.154"D.A.
23-80	.0148 g^2/cps	18.5-250	2.69 g zero to peak
80-110	12 db/oct rise to	250-380	.00085" D.A.
110-950	.0444 g^2/cps	380-2000	6.15 g zero to peak
950-1200	12 db/oct rolloff to		
1200-2000	.0148 g^2/cps		

Input to Equipment Supports From Interior Primary Structure
(Use for LGC, CDU, PSA/SCA, & Wiring Harness "A")

Random	5 Min./Axis	Sinusoidal -	3 oct/min. 1 sweep from 5 cps to 2000 cps to 5 cps
10-23 CPS	12 db/oct rise to	5-16 CPS	.154" D.A.
23-80	.0148 g^2/cps	16-250	1.92 g zero to peak
80-100	12 db/oct rise to	250-420	.00062" D.A.
100-1000	.0355 g^2/cps	420-1000	5.39 g zero to peak
1000-1200	12 db/oct rolloff to	1000-2000	6.15 g zero to peak
1200-2000	.0148 g^2/cps		

C-2

Input to Ascent Stage Equipment
(Use for all Equipment)

Random	21 Min/Axis	Sinusoidal -	1/2 oct./min - 1 sweep from 5 cps to 2000 cps to 5 cps
10-20 CPS	12 db/oct rise to	5-17 CPS	.10" D.A.
20-100	.0201 g^2/cps	17-310	1.54 g
100-120	12 db/oct rolloff to	310-500	.00030" D.A.
120-2000	.0100 g^2/cps	500-2000	4.0 g

During the lunar descent and ascent phases of flight the LEM is exposed to random vibration of varied levels and spectra for 21 minutes. In addition, the environment is considered to include peak vibration levels which are represented by the above sinusoidal vibration envelopes. The number of sinusoidal peaks for design may be considered to be 1 percent of the natural frequency of the equipment and its supporting structure times the number of seconds of exposure. For design purposes, the above random spectrum and sinusoidal levels applied separately for 21 minutes along each of the three mutually perpendicular axes X, Y, Z are considered to adequately represent the vibration environment.

C. Vibration (Cont'd)

The following vibration environments are the current best estimates for mission or operational simulation for lunar descent only. Data applicable to ascent operation will be provided when available. These mission levels represent the response near the LEM Navigation Base due to the maximum anticipated engine oscillatory thrust, using current LEM modes. They may be used as inputs from the Grumman Navigation Base to the MIT Navigation Base for purposes of performance evaluation, not for structural design.

0.036 in. D.A. at 14 cps Logarithmic decrease to 0.0034 in. D.A. at 60 cps 0.6g constant; 60 cps to 2000 cps	Linear Vibrations
1.00 milliradians D.A. at 14 cps Logarithmic decrease to 0.21 milliradians D.A. at 60 cps 15 Rad/Sec^2 constant; 60 cps to 2000 cps	Rotational Vibrations

Mechanical characteristics of support structure for LGC, PSA/SCA and CDU will be supplied when equipment mounting details are available.

The limitations of the Mathematical Model yielded direct calculations of response over the frequency range of 14 cps to 60 cps. Therefore, the values have been extrapolated above 60 cps.

D. Pressure

The following environments apply to all equipment within the crew cabin.

For appropriate Time History of Cabin Pressure, See Figure 2.

1) Cabin environment varies from 20.5 psia pressure at sea level to 5.4 psia (O_2).

2) 4.8 to 5.2 psia controlled cabin (O_2); 5.8 psia to .1 psia uncontrolled cabin (O_2)

3) 4.8 to 5.2 psia controlled cabin (O_2).

4) 4.8 to 5.2 psia (O_2) controlled cabin
3 x 10^{-9}mm Hg cabin (hatch open) *

*Hatch open conditions exist for a maximum of 20 minutes for each opening. Design for a total of 4 repressurizations.

For all equipment located between the heat shield and the crew cabin, the following environments apply:

5) Atmospheric pressure at sea level to 1 x 10^{-8}mm Hg (N_2)

6) 1 x 10^{-10}mm Hg uncontrolled vacuum.

For the part of the AOT outside the heat shield the following environments apply:

7) Atmospheric pressure at sea level to 1 x 10^{-8}mm Hg (N_2)

8) 1 x 10^{-14}mm Hg (Space)
9) 1 x 10^{-12} mm Hg (Uncontrolled vacuum and surface of moon)

E. Temperature and Plume Effects

For temperature and plume effects see ICD LIS-510-10001.

F. Humidity

Humidity products are composed mainly of perspiration and breath moisture. Minor amounts are due to water escaping from the reconstitution of food systems and outgassing of materials.

F. Humidity (Cont'd)

The following environments apply as shown:

	All Equip't. within the crew cabin	All Equip't Outside of Crew Cabin	Time (Max)
1)	None	* None	4.8 hrs.
2)	40-70% - Controlled Cabin 0-100% - Uncontrolled Cabin	None None	2.5 hrs. 117.5 hrs.
3)	40-70% - Controlled Cabin 0-100% - Locally in Cabin	None None	48 hrs.

* Dry nitrogen purge just prior to launch

G. Meteoroids (Applicable only to equipment outside of the Crew Cabin) - The meteroid flux density beneath the heat shield is the same as outside the heat shield.

1) The meteoroid environment for the LEM mission consists of sporadic and shower meteoroids defined as follows:

a) Sporadic Meteoroids

$$\mathrm{Log}_{10}N = -1.34\ \mathrm{Log}_{10}M \quad -10.423 + \mathrm{Log}_{10}(R)$$

Density = 0.5 gms/cc, all sizes

Velocity = 30 km/sec., all sizes

R = ratio of monthly flux to yearly average - see Fig. 4

where N = number of impacts per sq. ft. per day

M = mass in grams

b) Shower Meteoroids

$$\mathrm{Log}_{10}N = -1.34\ \mathrm{Log}_{10}M \quad -2.68\mathrm{Log}_{10}V - 6.465 + \mathrm{Log}_{10}F$$

Density = 0.5 gm/cc, all sizes

F = ratio of shower to sporadic rates, given in Fig. 3

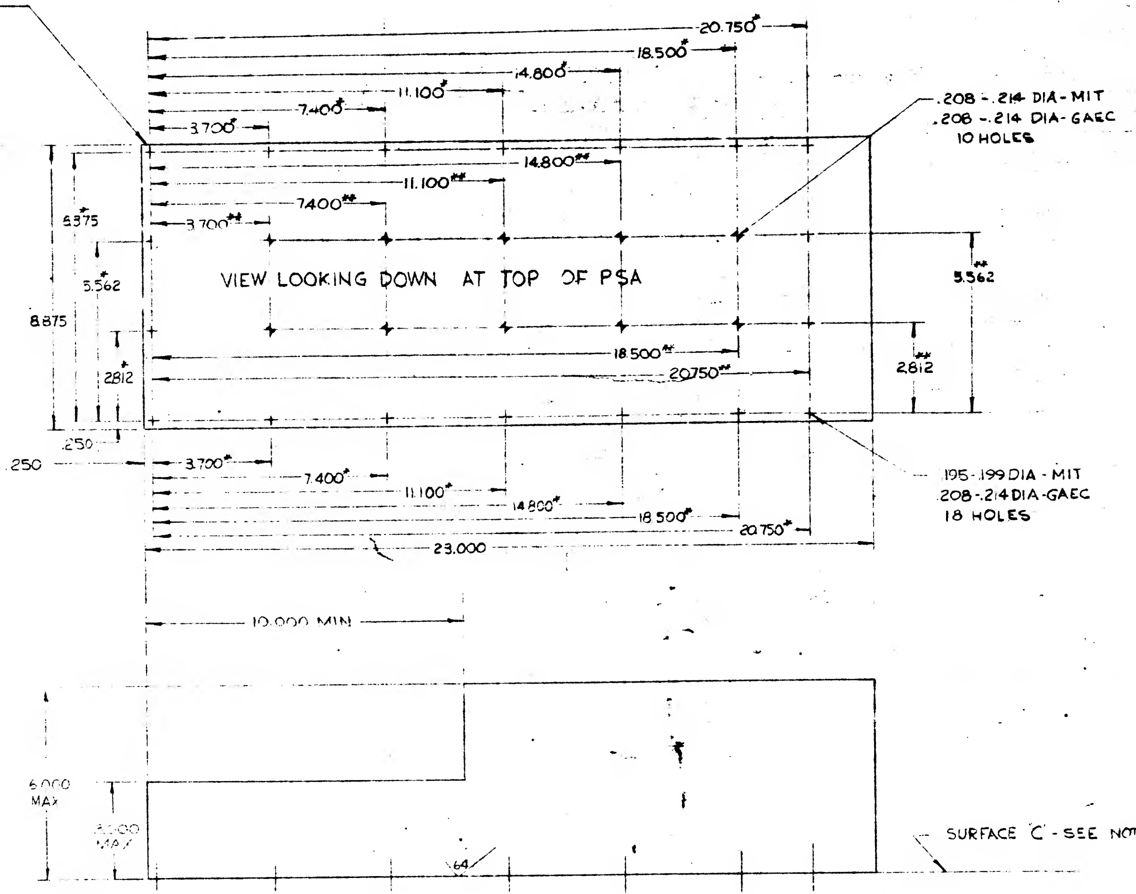
V = velocity in km/sec, as noted in Fig. 3

H. Radio Frequency

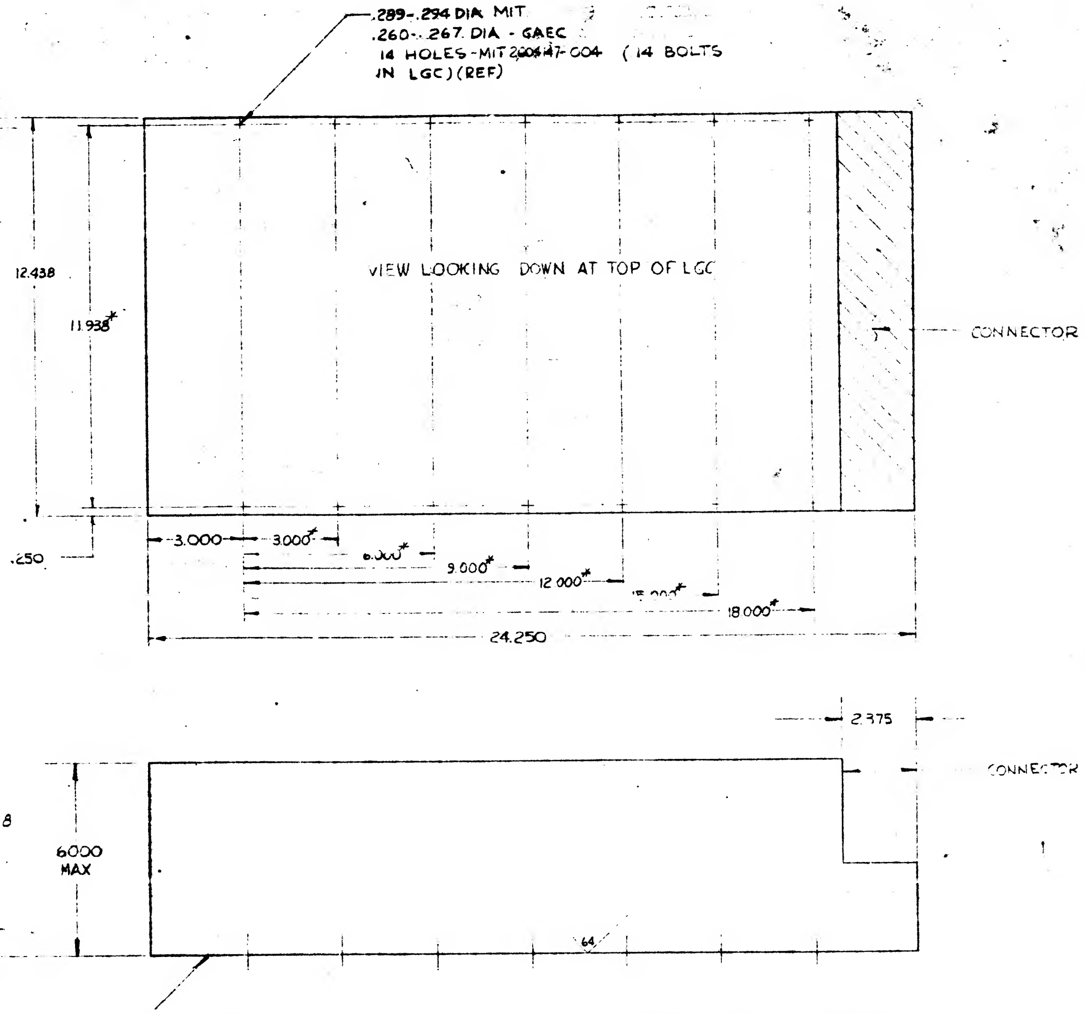
Background R. F. radiation levels shall not exceed the susceptibility limits specified in MIL-I-26600/MSC EMI-10A.

ON PSA DIMENSIONS MARKED(*) HAVE THE FOLLOWING TOLERANCES;
±.003 - MIT
±.005 - GAEC

ON PSA DIMENSIONS MARKED(**) HAVE THE FOLLOWING TOLERANCES
±.0075 MIT
±.005 GAEC



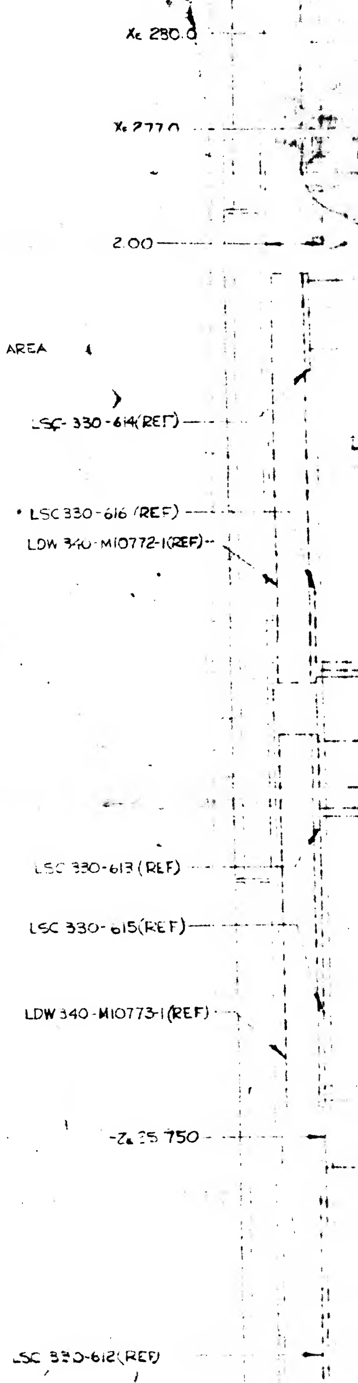
⑮ DETAIL C ENVELOPE DIMENSIONS & MOUNTING HOLE LOCATIONS FOR PSA & G&N SIGNAL CONDITIONER (MIT-124994)

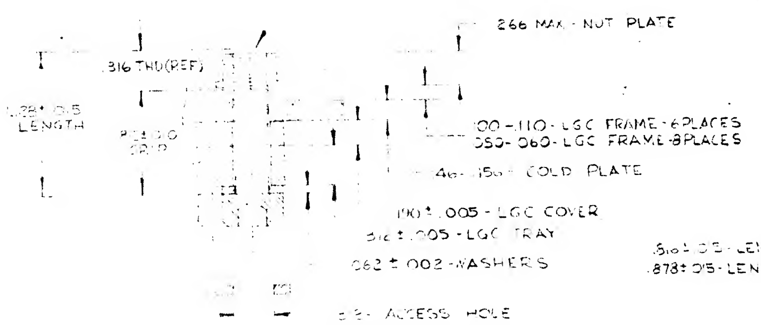


SURFACE 'A' - SEE NOTE*8

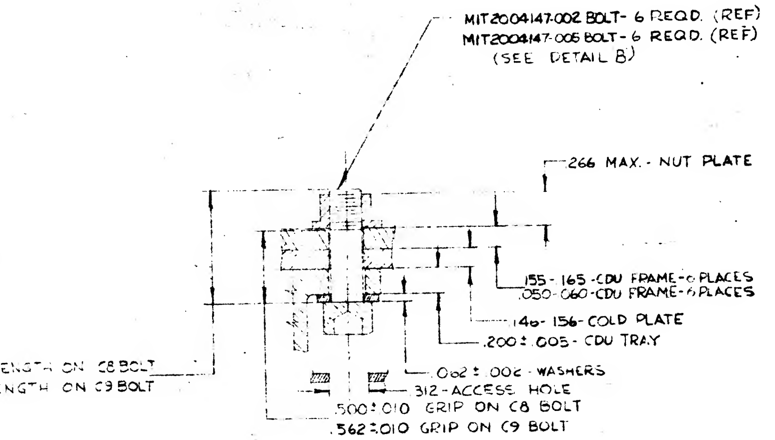
⑪ DETAIL 'A' ENVELOPE DIMENSIONS & MOUNTING HOLE LOCATIONS OF LGC (MIT-J-124965C)

ON LGC & CDU, DIMENSIONS MARKED (*) HAVE THE FOLLOWING TOLERANCES;
±.003 - MIT
±.006 - GAEC

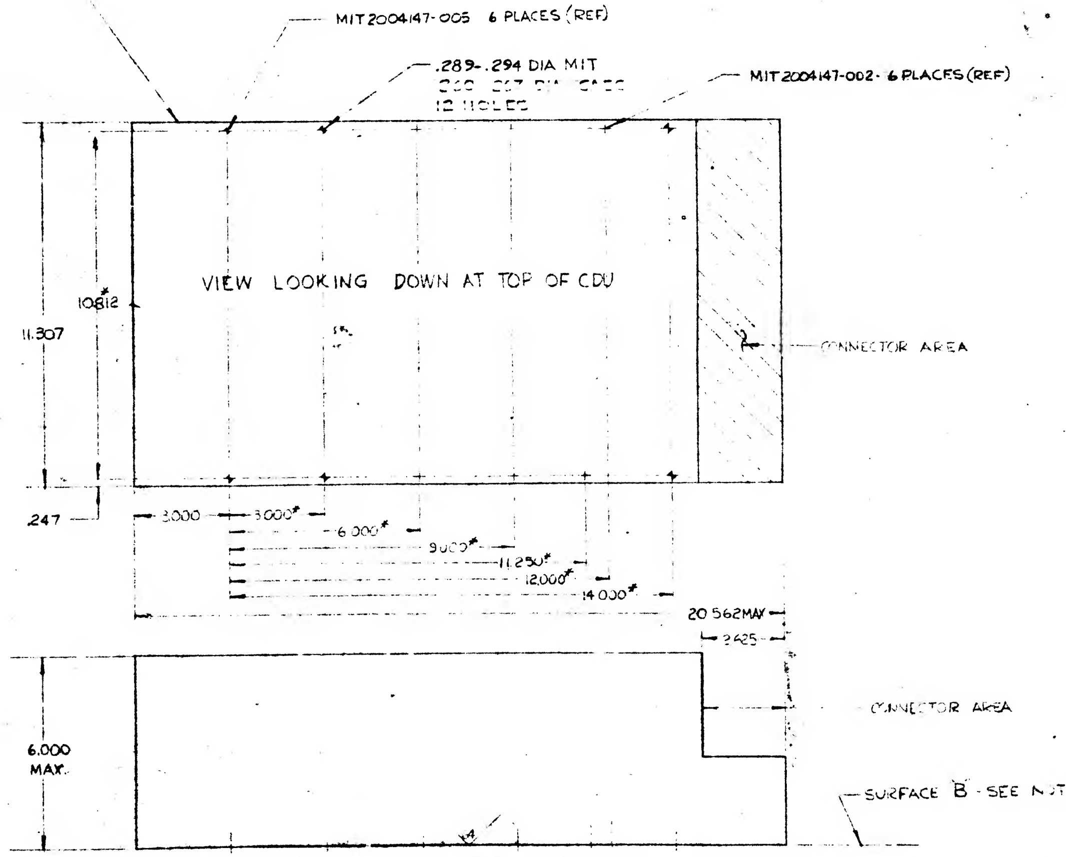




BOLT INSTL - LGC TO LEM
SCALE - 2X


MIT2004147-002 BOLT - 6 REQD. (REF)
MIT2004147-005 BOLT - 6 REQD. (REF)
(SEE DETAIL B)
.266 MAX. - NUT PLATE
.155 - .165 - CDU FRAME - 6 PLACES
.050 - .060 - CDU FRAME - 6 PLACES
.146 - .156 - COLD PLATE
.200 ± .005 - CDU TRAY
.062 ± .002 - WASHERS
.312 - ACCESS HOLE
.500 ± .010 GRIP ON C8 BOLT
.562 ± .010 GRIP ON C9 BOLT
.810 ± .015 - LENGTH ON C8 BOLT
.878 ± .015 - LENGTH ON C9 BOLT

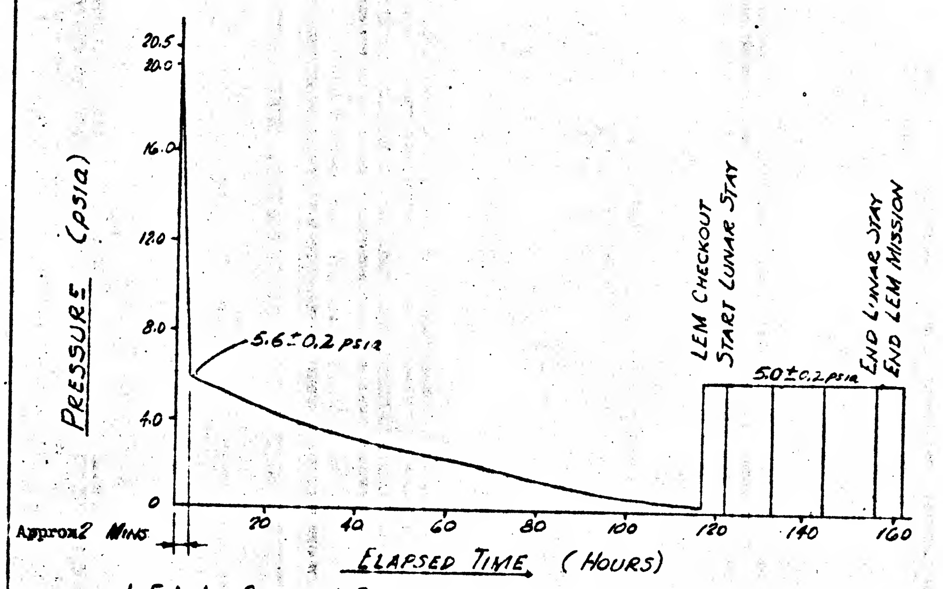
BOLT INSTL - CDU TO LEM
SCALE 2X



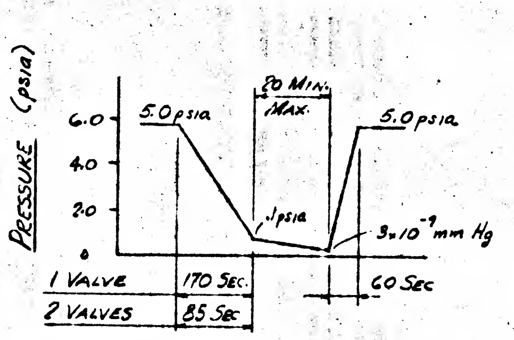
⑬ DETAIL 'B' ENVELOPE DIMENSIONS & MOUNTING HOLE LOCATIONS OF CDU (MIT-J-124985C)

I. **Acoustics:** Sound pressure levels external to LEM (ref. .0002 dynes/cm^2)
For a time history see Fig. 5.

Octave Band (cps)	Level (db)
9 to 18.8	136
18.8 to 37.5	142
37.5 to 75	146
75 to 150	143
150 to 300	139
300 to 600	135
600 to 1200	130
1200 to 2400	125
2400 to 4800	119
4800 to 9600	113
Overall	150



LEM CREW COMPARTMENT ENVIRONMENT
PRESSURE VS. ELAPSED TIME



NOMINAL BLOW-DOWN & RECOMPRESSION TIME

FIG 2

RATIO OF ACCUMULATIVE SHOWER FLUX TO THE SPORADIC FLUX FOR A CALENDAR YEAR

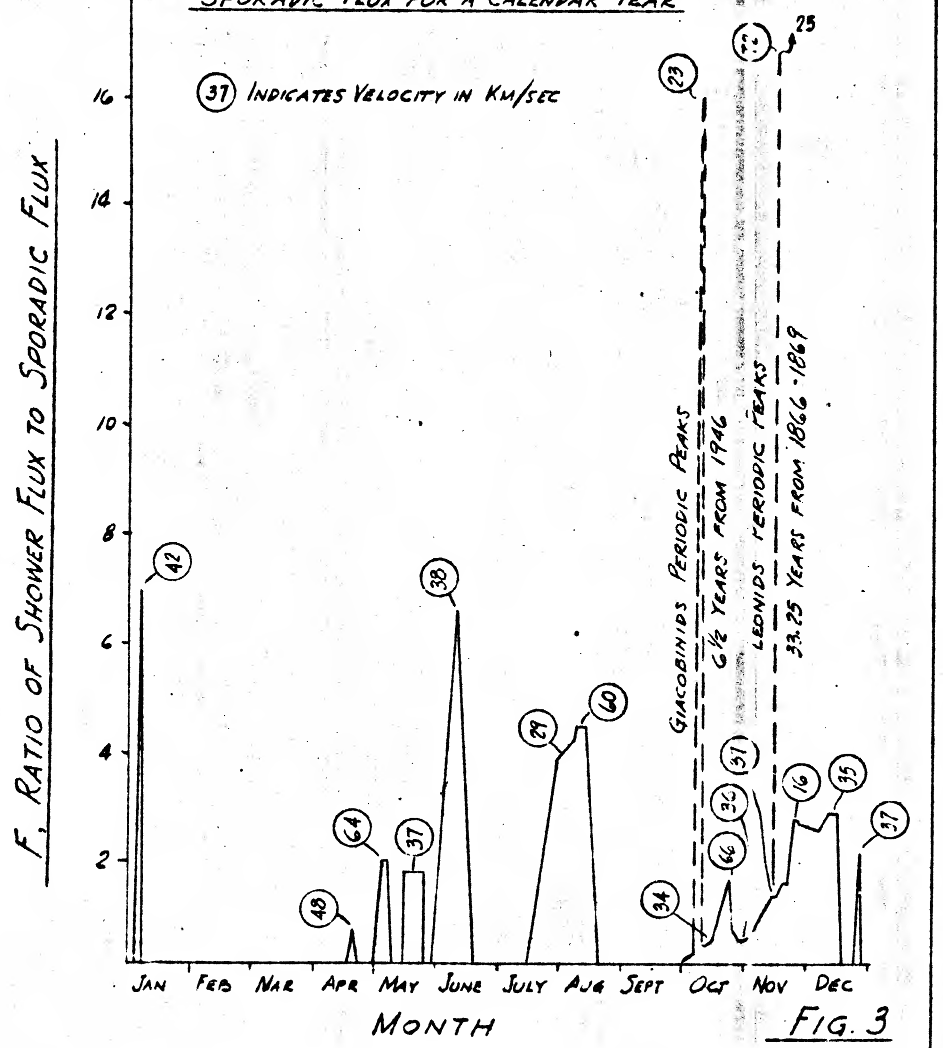


FIG. 3

MONTHLY VARIATION OF SPORADIC FLUX

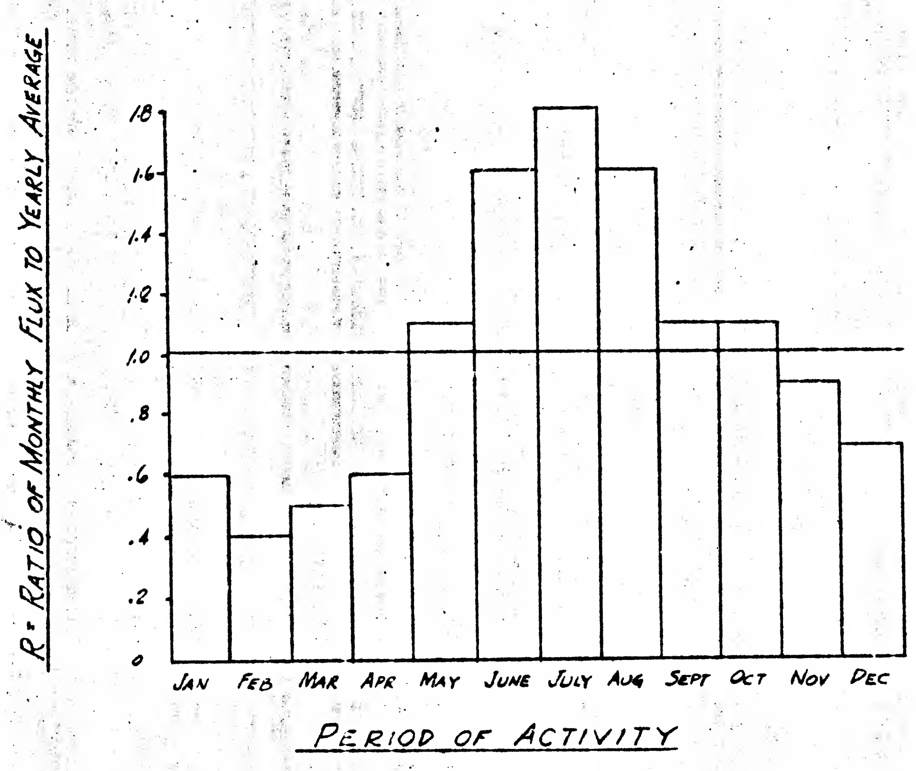


FIG 4

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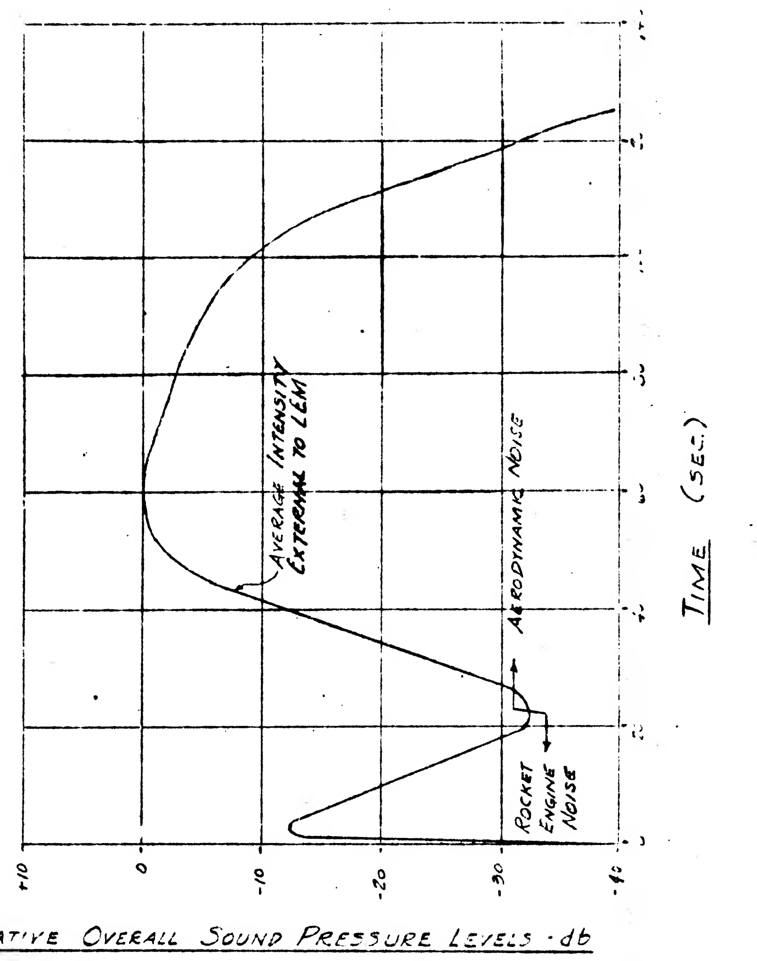

TIME HISTORY OF OVERALL EXTERNAL ACOUSTIC LEVELS

(REF. · NAA · ARM 5·2)

FIG. 5

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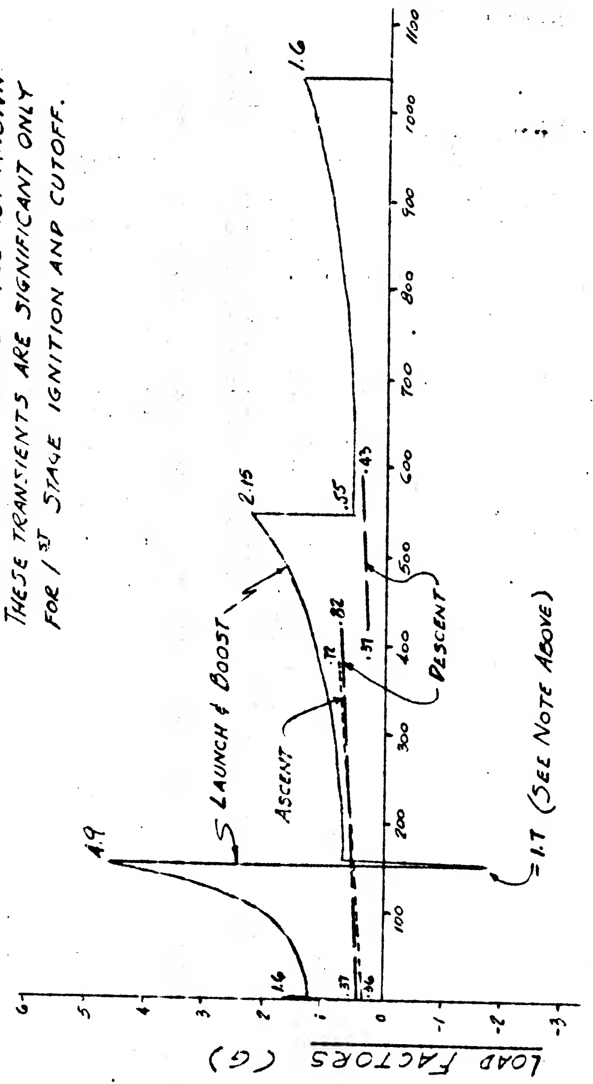
NOTE · APPROXIMATE MAGNITUDE FOR TRANSIENTS SHOWN. TIME HISTORIES ARE NOT KNOWN. THESE TRANSIENTS ARE SIGNIFICANT ONLY FOR 1ST STAGE IGNITION AND CUTOFF.



TIME HISTORY - ACCELERATIONS

FIG. 6

INTERFACE CONTROL DOCUMENT	SHEET 18 OF 18	ICD NO. LIS-520-10001 JUL 27 1965	REV

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